

GCSE Exam Questions

1a. Materials are classified as solid, liquid or gas according to their properties. For each state give two typical properties.

Solid (2)
Liquid (2)
Gas (2)

b. The melting and boiling points of six substances are given below.

Substance	Melting point/°C	Boiling point/°C
Nitrogen	-210	-196
Carbon disulphide	-112	46
Ammonia	-78	-34
Bromine	-7	59
Phosphorus	44	280
Mercury (II) chloride	276	302

(Room temperature is taken as 20°C.)

(i) Which element is a solid at room temperature? (1)

(ii) Which compound is a liquid at room temperature? (1)

(iii) Which compound is a gas at room temperature? (1)

(iv) Which element will condense when cooled to room temperature from 100°C? (1)

(v) Which compound will freeze first on cooling from room temperature to a very low temperature? (1)

(vi) Which of the six substances is a liquid over the widest range of temperature? (1)

(vii) Draw diagrams to show how the particles are arranged in bromine and in ammonia at room temperature. (4)

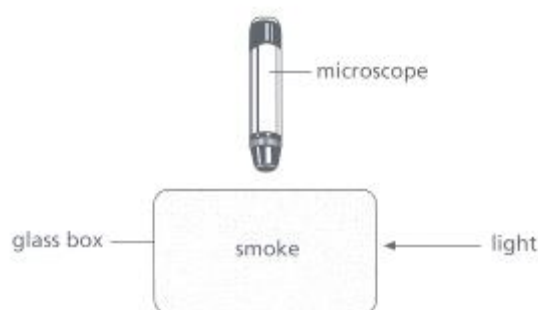
c. Using the ideas of the kinetic theory explain why

(i) a metal expands on heating (3)

(ii) a gas changes to a liquid on cooling (3)

(iii) a sample of water left in a dish at room temperature will evaporate over a period of time. (3)

d. A student used the apparatus below to observe smoke particles.



The student observed that the smoke particles moved randomly with a jerky, haphazard movement.

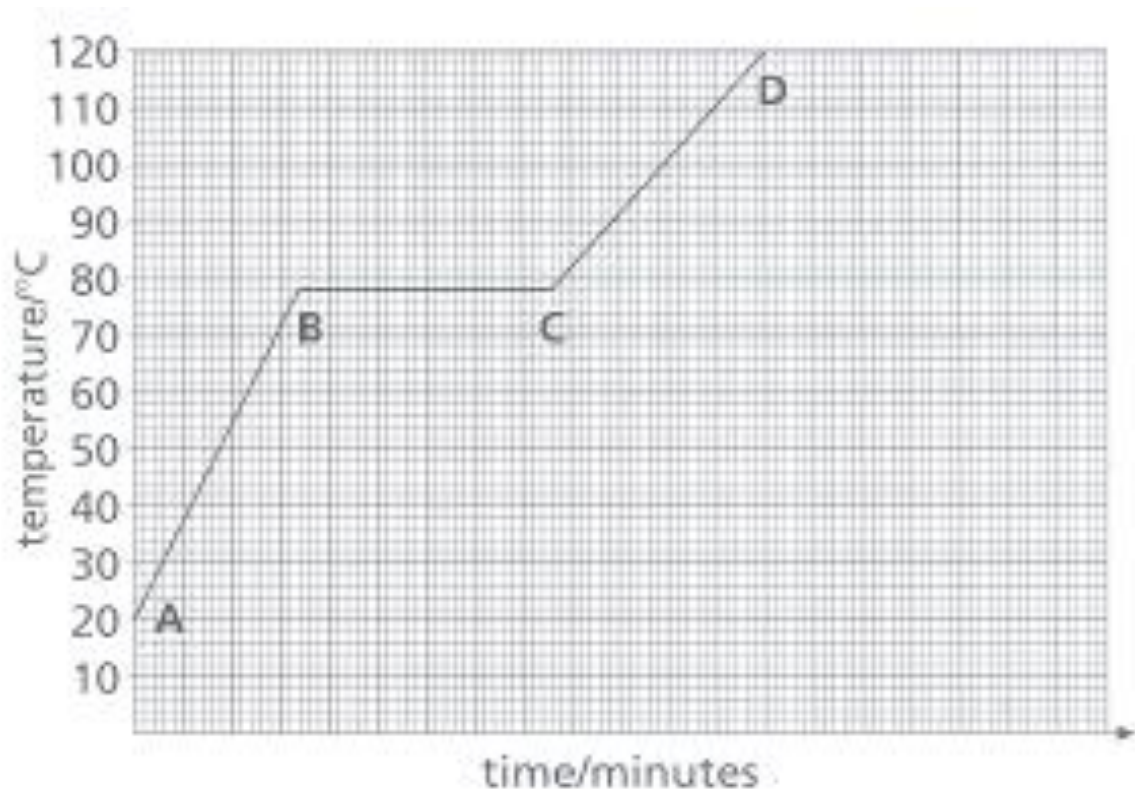
(i) Explain the student's observations. (3)

(ii) What is the name given to this type of movement? (1)

(CCEA, GCSE, Paper 2, June 1999)

2. This question is about the changes of state which take place when a pure substance is heated.

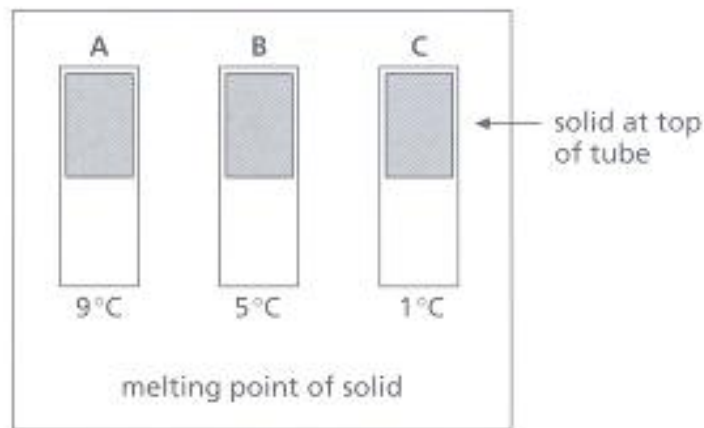
Some of the pure substance is placed in a test-tube and is heated steadily. The temperature of the substance is measured at regular intervals. The results of this experiment are shown on the graph.



- a. What is the melting point of the substance? (1)
- b. On which part of the graph is the substance completely liquid? (1)
- c. Explain the shape of the graph. Use your knowledge of energy and forces between particles in your answer. (4)

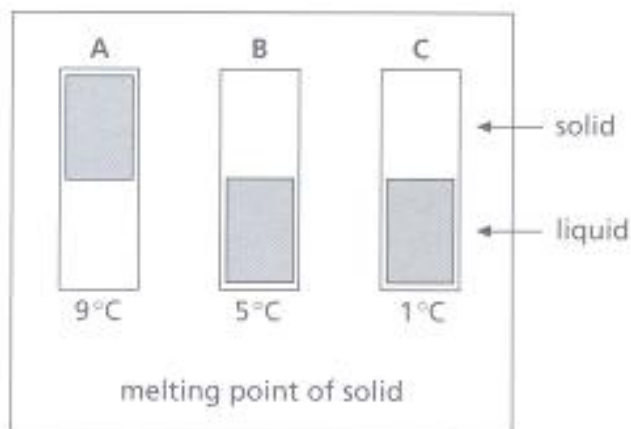
(OCR, GCSE, Paper 2, June 1999)

3. A fridge has three tubes to show if the temperature gets too high. Each tube contains a solid that melts at a different temperature. The solid stays at the top of the tube. When it melts, it drops to the bottom.



a. The temperature inside the fridge is 3 °C. Which tubes will contain solid at this temperature? (2)

b. This is what the tubes look like in one fridge.

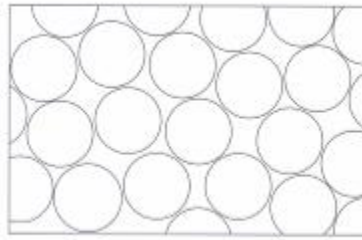


Copy and complete these two sentences.

The temperature of the fridge is above _____ °C.

The temperature of the fridge is below _____ °C. (2)

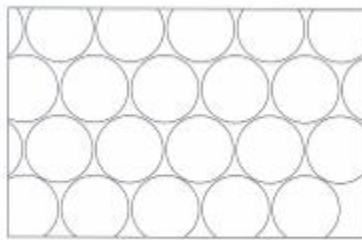
The contents of the tubes are made of particles.



A



B



C

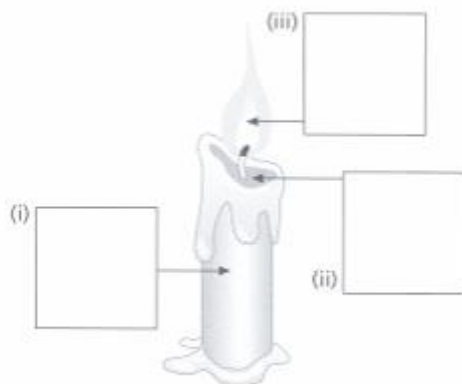
c. Which box shows the particles in a solid? (1)

d. Which box shows the particles in a liquid? (1)

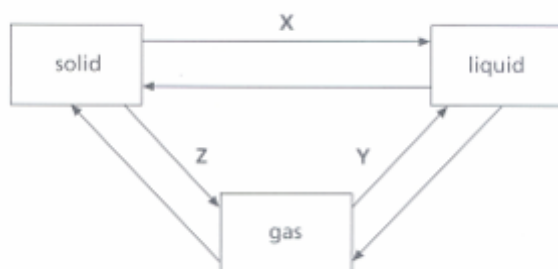
e. What happens to the particles when the solid melts? (1)

(OCR, GCSE, Paper 1, June 2000)

4a. The diagram below shows a burning candle. Draw the arrangements of the particles at positions (i), (ii) and (iii). (3)



b. It is possible to interchange the states of matter. The following diagram shows these changes.



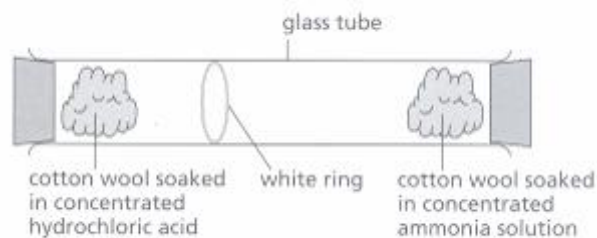
(i) Name the changes X, Y and Z. (3)

(ii) Which of the changes X, Y or Z is achieved by a decrease in temperature? (1)

c. Soft solder is a mixture of lead and tin. Heat is given out when it changes from liquid to solid. Explain this in terms of particle theory. (2)

d. Explain the essential difference between the evaporation of water and the decomposition of water. (2)

e. The following apparatus was set up to investigate the movement of two gases.



- (i) What name is given to the movement of gases? (1)
- (ii) Name the gas given off by concentrated hydrochloric acid. (1)
- (iii) Explain fully why the white ring was formed closer to the concentrated hydrochloric acid end of the tube. (2)
- f. A gas syringe contains 80 cm^3 of gas at 280 K and 1 atmosphere pressure. What pressure would this same amount of gas exert if the volume was decreased to 40 cm^3 and the temperature increased to 350 K ? (4)

(CCEA, GCSE, Paper 2, June 2000)

5a. Ice melts when it is heated. Explain clearly what happens to the water molecules as a piece of ice melts. (4)

b. Solid carbon dioxide is sometimes known as dry ice. Under normal circumstances dry ice sublimates as it warms up. Explain clearly the difference between melting and subliming. (2)

c. In an experiment, a student collected 100 cm^3 of carbon dioxide at 300K and 1 atmosphere pressure. What volume would this amount of gas occupy if the conditions were changed to 450 K and 2 atmospheres pressure? (4)

(CCEA, GCSE, Paper 2, June 1998)

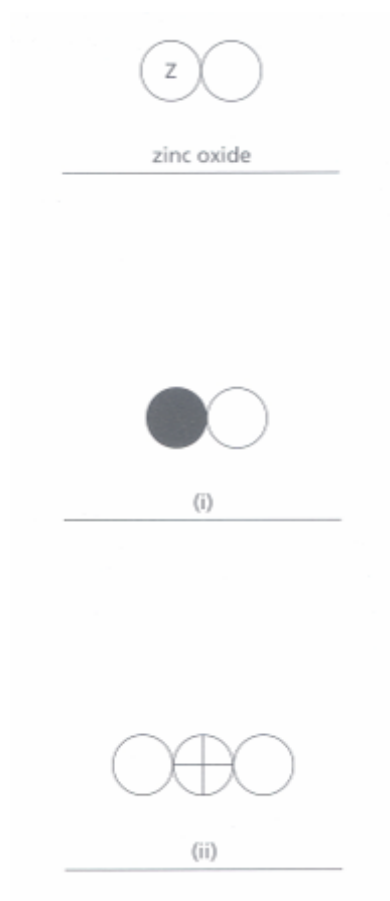
6. John Dalton was a famous chemist who lived 200 years ago. He made a list of substances he thought were elements. He gave symbols to these elements. Here is a copy of his table.

ELEMENTS					
	Hydrogen	^{wt} 1		Strontian	^{wt} 46
	Azote	5		Barytes	68
	Carbon	5 ⁴		Iron	50
	Oxygen	7		Zinc	56
	Phosphorus	9		Copper	56
	Sulphur	13		Lead	90
	Magnesia	20		Silver	190
	Lime	24		Gold	190
	Soda	28		Platina	190
	Potash	42		Mercury	167

a. We now know that some substances (such as hydrogen, carbon, oxygen and zinc) are elements.

Write down the names of two other substances in his list that we now know are elements. (2)

b Here are three compounds shown using Dalton's symbols. Write down the names of the compounds solution. One has been done for you. (2)



c. Dalton stated that:

1. All elements are made up of atoms.
 2. Atoms cannot be split up into simpler particles. We now know that atoms contain smaller particles. Describe the structure of an atom such as carbon.
- (4)

(OCR, GCSE, Paper 2, June 1999)

7a. Elements can be divided into metals and non-metals according to their physical properties. Metals in general have a lustre, are solid at room temperature, malleable and ductile.

(i) Give two other physical properties of metals not mentioned above. (2)

(ii) What is the meaning of the following terms?

Lustre (1)

Malleable (1)

Ductile (1)

b. The chemical properties of elements are also used to distinguish between metals and non-metals. Most metals react with acids.

(i) Give a word equation for the reaction of a metal with a dilute acid. (2)

(ii) Name one metal which reacts dangerously with a dilute acid. (1)

(iii) Name one metal which does not react with dilute acids. (1)

(iv) One metal which also reacts with alkalis is aluminium. Give a balanced symbol equation for the reaction of aluminium with sodium hydroxide (2)

(CCEA, GCSE, Paper 2, June 1999)

8a. Name the following hazard symbols:

(2)



b. The following is a list of some classes of materials: metals ceramics glass plastics fibres.

Choose from the above list the class to which the following materials A–E belong.

(i) A is flexible, easily melted, can be moulded and does not conduct electricity. (1)

(ii) B is hard, non-transparent, strong when compressed but weak when stretched. It is brittle, high melting and resistant to heat. (1)

(iii) C has the same properties as B but is transparent. (1)

(iv) D is strong, hard, can be bent and is a good conductor of both heat and electricity. (1)

(v) E is flexible and is formed from long, strong, hair-like strands. (1)

c. Copper metal is often used in central heating systems. Give two properties of copper which makes it suitable for this purpose. (2)

(CCEA, GCSE, Paper 2, June 1998)

a. Complete the following paragraph.

The greatest contributor to the development of the periodic table was the Russian scientist (i) _____ in 1869. He stated 'when elements are arranged in order of increasing (ii) _____, similar properties recur at intervals'. He recorded what he knew about each element on a separate card and then sorted the cards into 'piles of elements' with similar properties. His inspiration was to leave 'gaps' for (iii) _____ elements. Nowadays the elements of the periodic table are arranged in order of increasing (iv) _____. The table is divided into rows and columns. The rows are called (v) _____ and the columns are called (vi) _____. (6)

b. The following diagram shows the positions of some elements in the periodic table. Answer the following questions using only those elements shown.

(i) Name the element in row 2 of column 3. (1) How many electrons would you expect in the outer shell of a bromide ion? (1)

[illegible]

(ii) How many electrons would you expect in the outer shell of a bromide ion? (1)

(iii) Write down the symbol of the most reactive element in column 2. (1)

(iv) Write down the symbol of an element which has a filled outer shell of two electrons. (1)

(v) Which two elements would react together most vigorously? (2)

(vi) Write a balanced, symbol equation for the reaction in part (v). (2)

c. Elements can be broadly classified as metals or non-metals. Name one element which is classified as a 'semi-metal' and briefly explain why it may be classified in this way. (2)

(CCEA, GCSE, Paper 2, June 1998)

10. John Newlands attempted to classify the elements in 1866. He tried to arrange all the known elements in order of their atomic weights. The first 21 elements in Newlands' Table are shown below.

	Column						
	a	b	c	d	e	f	g
Symbol	H	Li	Be	B	C	N	O
Atomic weight	1	2	3	4	5	6	7
Symbol	F	Na	Mg	Al	Si	P	S
Atomic weight	8	9	10	11	12	13	14
Symbol	Cl	K	Ca	Cr	Ti	Mn	Fe
Atomic weight	15	16	17	18	19	20	21

Use a periodic table in a data book to help you answer these questions.

a. In two of Newlands' columns, the elements match the first three elements in two groups of the modern periodic table. Which two columns, a to g, are these? (1)

b.(i) A group in the modern periodic table is completely missing from Newlands' Table. What is the number of this group?

(ii) Suggest a reason why this group of elements is missing from Newlands' Table. (1)

c. Give one difference between iron, Fe, and the other elements in column g of Newlands' Table. (1)

d. Give the name of the block of elements in the modern periodic table which contains Cr, Ti, Mn and Fe. (1)

e. Both Newlands and Mendeleev based their tables on atomic weights. Explain why the modern periodic table is based on proton (atomic) numbers. (2)

f. The atoms of elements in Group 1 of the modern periodic table increase in size going down the group.

Explain, in terms of electrons, how this increase in size affects the reactivity

of these elements.

(3)

(AQA, GCSE, Paper 2372, June 2000)

11. Use a periodic table in a data book to help you answer these questions.

a. A Russian chemist named Mendeleev produced a periodic table. His periodic table had the elements in order of increasing atomic mass. Find the elements potassium and argon in the periodic table.

Element	Symbol	Electron arrangement	Formulae of chlorides
Sodium	Na		NaCl
Magnesium	Mg	2,8,2	
Aluminium	Al		AlCl ₃
Silicon	Si		SiCl ₄
Phosphorus	P		PCl ₅
Sulphur	S		S ₂ Cl ₂
Chlorine	Cl		---

(i) What problem is caused by using atomic mass to place these elements in order? (1)

(ii) Show how this problem is solved for potassium and argon in a modern periodic table. (2)

The table below gives information about some elements in the third period of the periodic table.

b. There is a pattern in the electron arrangements of atoms of elements in this period.

(i) Complete the missing electron arrangements in the table. (2)

(ii) What is the connection between electron arrangement and the position of the element in the periodic table? (2)

c. There is a pattern in the formulae of chlorides in this period. Suggest the formula for magnesium chloride. (1)

d. Sodium reacts with cold water.

(i) Write down the names of the two products of this reaction. (1)

(ii) Write a balanced equation for this reaction. (2)

e. Potassium is in the same group of the periodic table as sodium.

(i) Write down the electron arrangement in a potassium atom. (1)

(ii) Explain why potassium reacts faster than sodium with cold water. (2)

(OCR, GCSE, Paper 2, June 1999)

12. In some nuclear reactors sodium metal is used to transfer heat. The sodium is heated to about 500°C by the reactor. The heat is transferred to water to produce steam.

a. Use a data book to help you answer this question. Is sodium a solid, a liquid or a gas when it has been heated by the nuclear reactor? (1)

b. One disadvantage of sodium is that it reacts with water. What happens when a small piece of sodium reacts with water? You should describe what you would see and state what substances are formed. (4)

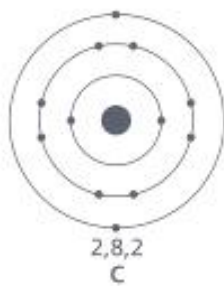
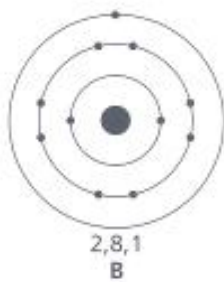
c. Use a data book to help you answer this question. When sodium reacts with water it forms sodium ions. The diagrams represent the electron arrangements of some atoms and ions.

Which of the diagrams, A to E, represents the electron arrangement of each of the following?

(i) a sodium atom, Na

(ii) a sodium ion, Na^{+} . (2)

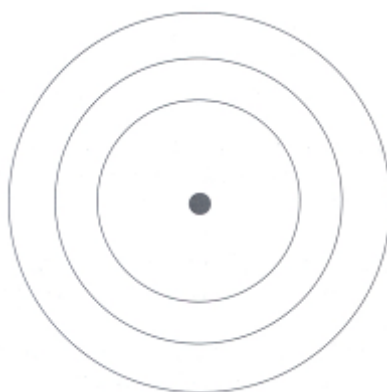
(AQA, GCSE, Paper 2372, June 1999)



13a. Use a periodic table in a data book to answer the following questions.

- (i) What is the mass number of fluorine? (1)
- (ii) How many protons are present in an atom of beryllium? (1)
- (iii) How many neutrons are present in an atom of aluminium? (1)
- (iv) Which element has the electronic structure 2, 8, 6? (1)
- (v) Which Group 0 element has the largest atom? (1)

b. Using X to represent an electron, copy and complete the following diagram to show the electronic structure for an atom of phosphorus. (1)



(WJEC, GCSE, June 2000)

14. The elements in Mendeleev's periodic table were arranged in order of increasing atomic mass. Part of the modern periodic table is shown.

		H			He		
Li	Be						
Na	Mg						
K	Ca						
		B	C	N	O	F	Ne
		Al	Si	P	S	Cl	Ar

a. Complete the sentence by writing out the missing words.

The modern periodic table is arranged in order of increasing _____. (1)

b (i) Name a metal in the same group as lithium. (1)

(ii) Name a non-metal in the same period as magnesium. (1)

c. The table contains some information about two elements.

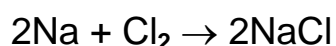
Element	Symbol	Number of		
		protons	neutrons	electrons
Fluorine	F	9	10	9
Chlorine	Cl	17	18	17
Chlorine	Cl	17	20	17

(i) In terms of atomic structure, give one feature that both these elements have in common. (1)

(ii) There are two isotopes of chlorine shown in the table. Explain what isotope means. (2)

(iii) Explain, in terms of electron arrangement, why fluorine is more reactive than chlorine. (2)

d. Sodium reacts with chlorine to form the compound sodium chloride.



Describe, in terms of electron arrangement, the type of bonding in:

(i) a molecule of chlorine (3)

(ii) the compound sodium chloride. (4)

(SEG, GCSE, Paper 6/4, Summer 2000)

15a. Find nickel on a periodic table.

(i) What name is given to metals in this part of the periodic table? (1)

(ii) What is the symbol for nickel? (1)

(iii) What is the atomic number of nickel? (1)

(iv) What is meant by the atomic number of an element?

A. Number of neutrons in an atom

B. Number of protons in an atom

C. Total number of protons and neutrons in an atom Which is correct (A, B or C)? (1)

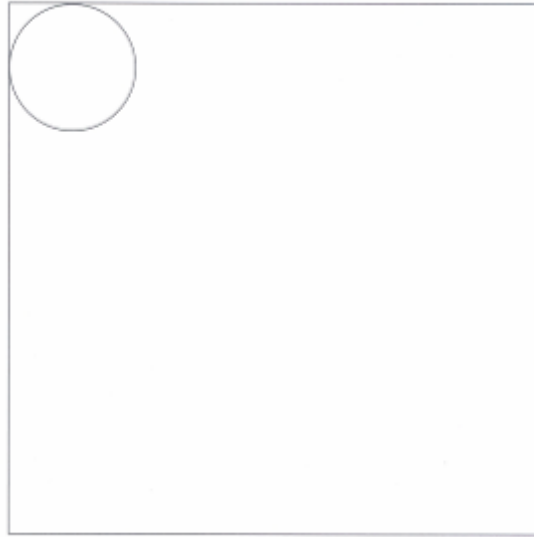
b. Use words from the box to complete the sentence.

gas liquid solid

When nickel melts, it changes from a (i) _____ to a (ii) _____. (1)

c. Nickel is made of atoms.

Copy the following diagram and draw circles in the box to show the arrangement of nickel atoms when it is a solid. One has been drawn for you.



(Edexcel, GCSE, Paper 2F/1 F, June 2000)

16a. Sodium, atomic number 11, reacts with chlorine, atomic number 17, to form sodium chloride.

(i) Give the electronic structures of the two elements, sodium and chlorine. (2)

(ii) Explain, by means of a diagram or otherwise, the electronic changes that take place during the formation of sodium chloride. Include the charges on the ions. (4)

(iii) The table below shows some physical properties of sodium chloride.

Using the information in the table above, state the type of structure found in sodium chloride. (1)

Melting point/°C	Boiling point/°C	Solubility in water
801	1413	Soluble

b. Chlorine gas, Cl_2 , consists of molecules. By means of a diagram, show the bonding in a chlorine molecule. (2)

Name this type of bonding. (1)

(WJEC, GCSE, June 2000)

17a. Lithium, atomic number 3, reacts with oxygen, atomic number 8, to form lithium oxide.

(i) Give the electronic structures of the two elements, lithium and oxygen. (2)

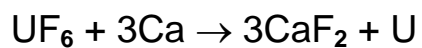
(ii) Explain, by means of a diagram or otherwise, the electronic changes that take place during the formation of lithium oxide. (4)

(iii) Give the chemical formula for lithium oxide. (1)

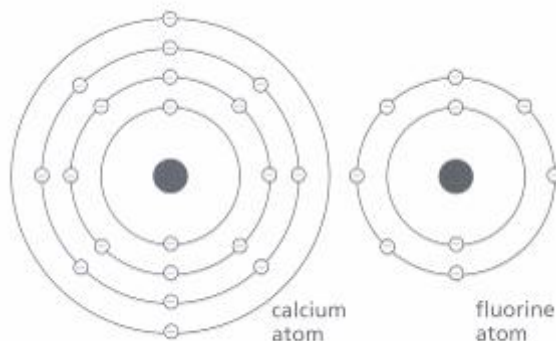
b. Oxygen, atomic number 8, forms a compound with hydrogen, atomic number 1, called water. By means of a labelled diagram, show how the atoms of oxygen and hydrogen are bonded together in water. (2)

(WJEC, GCSE, 0125/2, June 1999)

18. Uranium metal can be produced by reacting uranium hexafluoride with calcium.



a Describe how calcium and fluorine bond together to form calcium fluoride. The electron arrangement of each atom is shown. (5)



b. Uranium has two main isotopes, $^{235}_{92}\text{U}$ and $^{238}_{92}\text{U}$. Use these as examples to explain what is meant by the word isotope. (4)

(SEG, GCSE, Paper 6/4 June 1999)

19a. Complete the following passage:

Substances which are made up of atoms and cannot be simplified by chemical methods are called (i) _____. Atoms often combine with different types of atoms to form (ii) _____. Sometimes atoms will gain or lose electrons in chemical reaction to form charged particles called (iii) _____.
(3)

b. Copy and complete the following table relating to particles A, B⁺ and C²⁻ (The letters do not represent the symbols of the elements.)
(9)

Particle	Atomic number	Mass Number	Number of protons	Number of neutrons	Number of electrons
A	6			6	
B ⁺		39	19		
C ²⁻		16			10

c. (i) Draw a 'dot and cross' diagram to show how oxygen atoms become bonded together in oxygen gas. (Only the outer shell of electrons need be shown.)
(3)

(ii) Name the type of bond in part c (i).
(1)

d. Sodium is a soft silvery white metal with melting point 98°C. Using a diagram, describe how the atoms are held together in a piece of sodium metal.
(3)

e. Substances may be classified in terms of their physical properties. Use the table below to answer the following questions:

Substance	Melting point/°C	Boiling point/°C	Electrical conductivity	
			As solid	As liquid
A	3720	4827	Good	Poor
B	-95	69	Poor	Poor
C	327	1760	Good	Good
D	3550	4827	Poor	Poor
E	776	1500	Poor	Good

(i) Which substance could be sodium chloride?
(1)

Explain your answer. (2)

(ii) Which substance consists of small covalent molecules? (1)

Explain your answer. (2)

(iii) Explain why substance A could not be diamond. (2)

(CCEA, GCSE, Paper 2, June 1999)

20a. Chlorine is a non-metallic element which has an atomic number of 17 and can exist as isotopes. Explain what is meant by the terms in bold type.

(i) Atomic number (1)

(ii) Isotopes (2)

b. Chlorine exists as diatomic molecules. Show clearly how atoms of chlorine combine to form chlorine molecules. (Outer electrons only need to be shown.) (3)

c. Chlorine can form a range of compounds with both metals and non-metals.

(i) Explain carefully, using full electronic arrangements, how atoms of chlorine combine with atoms of calcium to form calcium chloride. (You may use a diagram to help you.) (6)

(ii) Name the type of bonding found in calcium chloride. (1)

(iii) Show clearly how atoms of chlorine combine with carbon to form tetrachloromethane CCl_4 . (Outer electrons only need to be shown.) (3)

(iv) Name the type of bonding found in CCl_4 . (1)

d. The properties of compounds depend very closely on their bonding. In the following table give the correct word to show some of the expected properties of calcium chloride and tetrachloromethane. (4)

Compound	Solubility in water	Relative melting point
Calcium chloride	(i) Soluble/Insoluble	(ii) Low/High
Tetrachloromethane	(iii) Soluble/ Insoluble	(iv) Low/High

e. The bonding in the elements calcium and carbon is very different. Describe clearly the bonding in

(i) calcium. (3)

(ii) carbon in the form of graphite. (3)

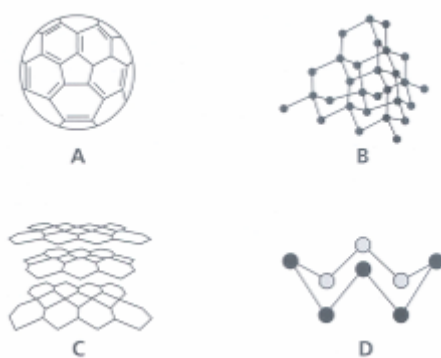
(iii) Both calcium and graphite can conduct electricity. State two properties of calcium which are different from graphite. (2)

(CCEA, GCSE, Paper 1, June 2000)

21. This advertisement appeared in a Do-It-Yourself magazine.



a. The drill bits have a 'diamond-like' hardness.



Which of these is a diamond structure? (1)

b. Use ideas about chemical bonds to explain why diamond is so hard. (4)

c. The drill tip has to be very hard, so it is made out of a different substance from the rest of the drill, the shank. The shank of the drill is made out of iron.



The advertisers have made the material of the drill tip sound new and exciting by calling it 'space-age Wolfram'. Wolfram is the old name for an element in the periodic table which is now called something else.

(i) What property in the table below makes Wolfram better than iron for use as a drill tip? Explain why. (2)

(ii) Wolfram and iron are in the same part of the periodic table. Using the atomic numbers of the elements, find Wolfram. What is the usual name for Wolfram? (1)

d. The tip of the drill becomes discoloured after it has been used. This is possibly because the Wolfram forms a layer of oxide, WO_3 , on its surface. Use the periodic table to help you predict the formula of

(i) Wolfram sulphide (1)

(ii) Wolfram chloride. (1)

e. In a laboratory experiment Wolfram was converted into Wolfram oxide, WO_3 .

(i) What mass of oxygen will react with 184 g of Wolfram? (A_r : W = 184; O = 16) (2)

(ii) A different oxide of Wolfram is made of 9.2 g of Wolfram and 1.6 g of oxygen. What is the formula of this oxide? Show your working. (A_r : W = 184; O = 16) (3)

(OCR, GCSE, Paper 2, June 2000)

Name	Symbol	Atomic number	Melting point/ $^{\circ}\text{C}$	Boiling point/ $^{\circ}\text{C}$	Density/ g cm^{-3}	Electrical conductivity
Iron	Fe	26	1535	2750	7.9	Good
Wolfram	W	74	3410	5660	19.4	Fair

22. To obtain full marks, the steps in the calculations in this question must be shown.

a. Calcium nitrate decomposes on heating according to the equation



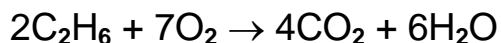
(i) Calculate the mass of calcium nitrate required to be heated in order to produce 2.8 g of calcium oxide. (Relative atomic masses: Ca = 40, N = 14, O = 16.) (4)

(ii) Calculate the volume of oxygen produced in the same reaction, measured at room temperature and pressure.

[1 mole of gas at room temperature and pressure occupies a volume of 24 dm³ (litres).] (3)

b. (i) State Avogadro's law. (3)

(ii) The hydrocarbon ethane, C₂H₆, undergoes complete combustion according to the following equation.

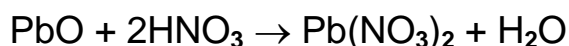


What volume of oxygen is required to completely combust 5 dm₃ of ethane? (2)

(CCEA, GCSE, Paper 1, June 2000)

23. To obtain full marks the steps in the calculations in this question must be shown.

a. The salt, lead(ii) nitrate, may be prepared in the laboratory by the reaction between lead(ii) oxide and nitric acid. The equation for the reaction is



In an experiment to prepare lead (II) nitrate crystals, a student placed 50 cm³ of nitric acid, concentration 0.5 mol dm⁻³ (moles per litre), in a beaker and warmed the solution. Solid lead (II) oxide was added with stirring until no more solid dissolved.

(i) Calculate the number of moles of nitric acid present in the 50 cm³ of nitric acid solution. (2)

(ii) Calculate the maximum mass of lead(ii) nitrate which could be obtained from the above experiment. (Relative atomic masses: N = 14, O = 16, Pb = 207.) (4)

b. When solid lead(ii) nitrate is heated it decomposes according to the equation



In an experiment a student heated 3.31 g of lead (II) nitrate until no further change took place.

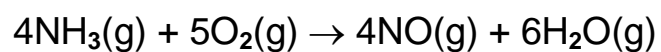
(i) Calculate the mass of lead (II) oxide formed. (Relative atomic masses: N = 14, O = 16, Pb = 207.) (4)

(ii) Calculate the volume of nitrogen dioxide gas, measured at room temperature and pressure, formed.

[1 mole of gas at room temperature and pressure occupies a volume of 24 dm³ (litres).] (3)

c. (i) State Avogadro's law. (3)

(ii) The equation for the catalytic oxidation of ammonia is

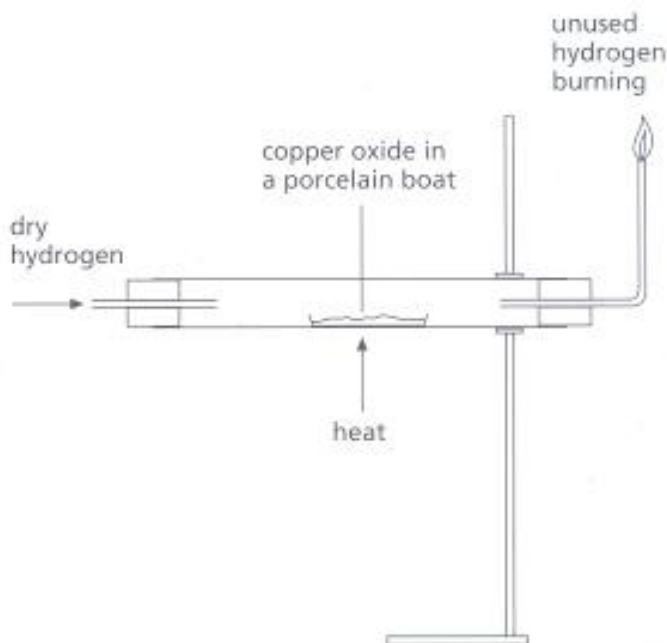


What volume of oxygen is needed to produce 10 dm³ of nitrogen monoxide?
(2)

(CCEA, GCSE, Paper 2, June 1998)

24. Copper oxide reacts with hydrogen. The hydrogen combines with the oxygen and copper is left.

In an experiment, some copper oxide is put into a porcelain boat inside a tube. Hydrogen gas is passed over the heated copper oxide until all the copper oxide has changed into copper. The apparatus used is shown in the diagram.



a. What type of change occurs to the copper oxide when it changes into copper? Is the copper oxide

neutralised, oxidised or reduced? (1)

b. (i) Here are the results of the experiment.

Calculate the two missing values.

Mass of empty porcelain boat	= 10.0g
Mass of boat and copper oxide before heating	= 17.2g
Mass of boat and copper after heating	= 16.4g
Mass of copper oxide before heating	= 7.2g
Mass of copper after heating	= ___ g
Mass of oxygen removed	= ___g

(2)

(ii) Work out the mass of oxygen needed to combine with 64 g of copper. You must show how you work out your answer. (2)

(iii) What is the formula of this oxide of copper? You must show how you work out your answer. (2)

(OCR, GCSE, Paper 4, June 2000)

25. Hydrazine is produced from ammonia. The equation which represents this reaction is:



a. What mass of ammonia, NH_3 , is needed to make 32 g of hydrazine, N_2H_4 ? (Relative atomic masses: H = 1, N = 14.) (2)

b. About 20000 tonnes of hydrazine are produced each year. What mass of ammonia is needed to make 20000 tonnes of hydrazine? (1)

(AQA, GCSE, Paper 2372, June 2000)

26a. What is the name given to the block of elements in the middle of the periodic table which includes vanadium? (1)

b. Some of the properties of vanadium are shown in this list.

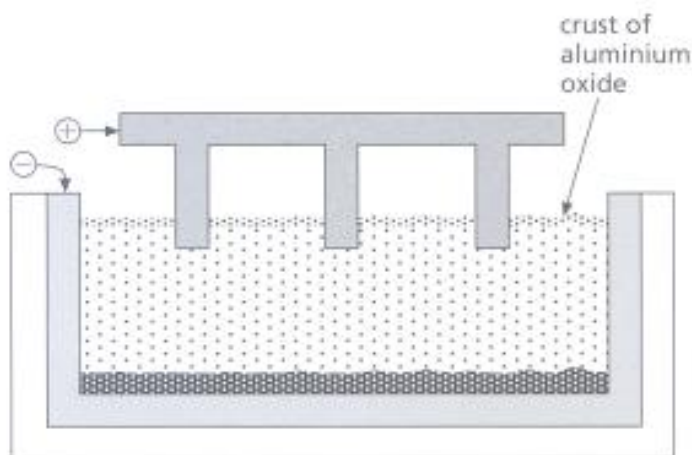
- It has a high melting point.
- It is a solid at room temperature.
- It is a conductor of electricity.
- It is a good conductor of heat.
- It forms coloured compounds.
- It forms crystalline compounds.
- It forms compounds that are catalysts.

Select two properties, from the list above, which are not typical of a Group 1 metal. (2)

c. One compound of vanadium is vanadium oxide. A sample of vanadium oxide contained 10.2 g of vanadium and 8.0 g of oxygen. Calculate the formula of this vanadium oxide. You must show all your working to gain full marks. (Relative atomic masses: V = 51, O = 16.) (3)

(AQA, GCSE, Paper 2372, June 1999)

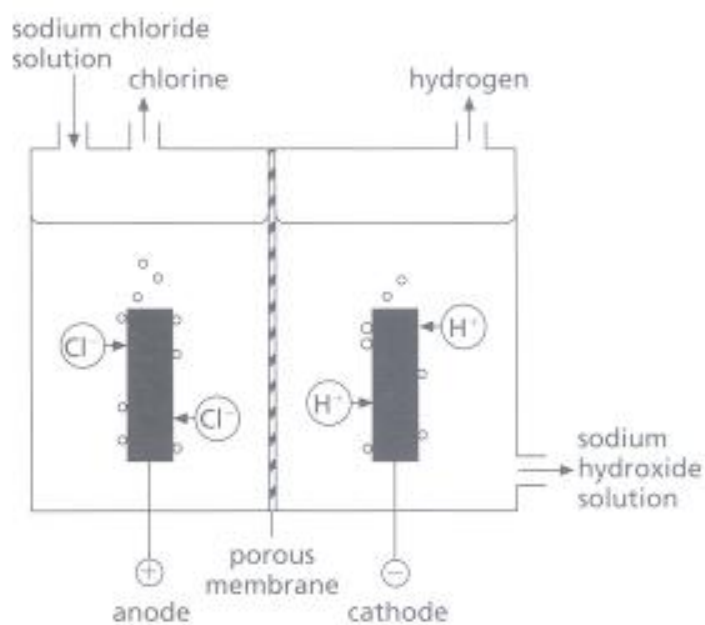
27. Aluminium metal is extracted from pure aluminium oxide by electrolysis using the cell shown below.



- Name the substance in which aluminium oxide is dissolved in this process. (1)
- Explain why the substance in part a is added. (3)
- Name the substance from which both electrodes are made. (1)
- At what temperature does the process take place? (1)
- Give a balanced, ionic equation for the reaction which takes place at the negative electrode. (2)
- Is the reaction in part e an oxidation or reduction? Explain your answer. (3)
- How is the product formed at the negative electrode removed from the cell? (2)
- Describe what happens at the positive electrode during electrolysis. (2)
- Give a balanced, ionic equation for the reaction in part h. (2)
- Which electrode has to be frequently replaced during the process? Explain your answer. (2)

(CCEA, GCSE, Paper 2, June 2000)

28. The industrial electrolysis of an aqueous solution of sodium chloride is shown.

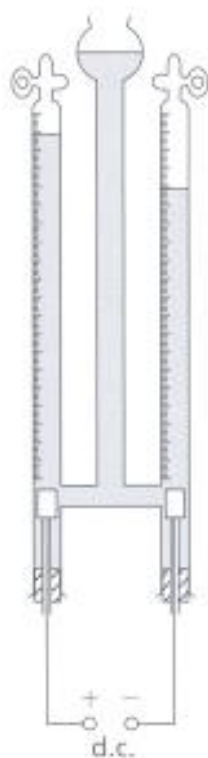


a. What is meant by electrolysis? (2)

b. Explain how hydrogen and sodium hydroxide solution are produced. (5)

(SEG, GCSE, Paper 5, Summer 2000)

29. Electrolysis of acidified water can be carried out in this apparatus. Hydrogen and oxygen are formed during the electrolysis.



a. The water, H_2O , is acidified with dilute sulphuric acid, H_2SO_4 . The ions present in the acidified water are H^+ , OH^- and SO_4^{2-} . Copy and finish the table by writing the symbols of the ions which move to each electrode. (2)

Move to anode (+)	Move to cathode (–)

b. The electrolysis was carried out for ten minutes.
 The hydrogen and oxygen were then removed.
 The experiment was started again.
 The volumes of hydrogen and oxygen collecting were measured every two minutes.
 The current was not changed.
 The table shows how much hydrogen was formed.

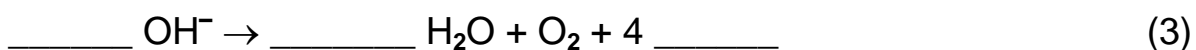
Time/min	0	2	4	6	8	10
Volume of hydrogen/ cm^3	0	4	8	12	17	20

(i) Plot these results on a grid. Draw the best fit line for this graph. (3)

(ii) Draw another straight line on the grid to show the volume of oxygen collected during the experiment. (1)

(iii) If the electrolysis is repeated using fresh acidified water, less oxygen is collected. Suggest why. (1)

c. Copy and complete this ionic equation for the reaction taking place at the anode.



d. The reaction at the cathode is represented by this equation.



In an electrolysis 20 cm³ of hydrogen are released, measured at room temperature and pressure.

(i) Calculate the number of moles in this 20cm³ of hydrogen gas. (1 mole of gas occupies 24000 cm³ at room temperature and pressure.) (1)

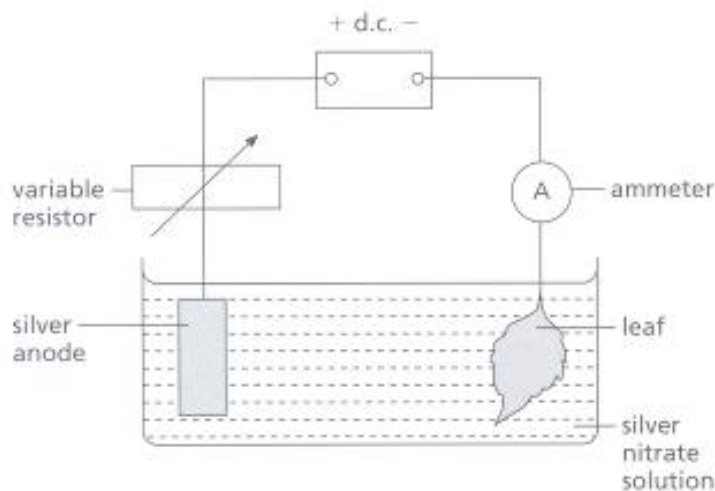
(ii) Show, by calculation, that the quantity of electricity required to produce this amount of hydrogen gas is 160 coulombs. (One faraday is 96000 coulombs.) (2)

(iii) What current would be needed to produce this amount of hydrogen gas in 5 minutes? You must show how you work out your answer. (2)

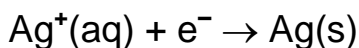
(OCR, GCSE, Paper 4, June 2000)

30. A small leaf is to be made into a piece of jewellery by plating it with silver. The leaf is first covered in graphite paste. Then it is made the cathode (negative electrode) in a circuit set up for electrolysis.

Here is a diagram of the circuit.



- a. Why is the leaf coated with graphite paste? (1)
- b. In carrying out this electrolysis, a constant current is used. How is the current kept constant in this circuit? (1)
- c. Which of the following conditions is likely to give the best coating?
- A. a large current for a long time
 - B. a large current for a short time
 - C. a small current for a long time
 - D. a small current for a short time
- d. Direct current (d.c.) is used in this process. Why is alternating current (a.c.) not used? (1)
- e. A constant current of 0.1 A passes through the electrolysis cell. 0.108 g of silver is deposited on the leaf. The reaction at the cathode is shown by the equation.



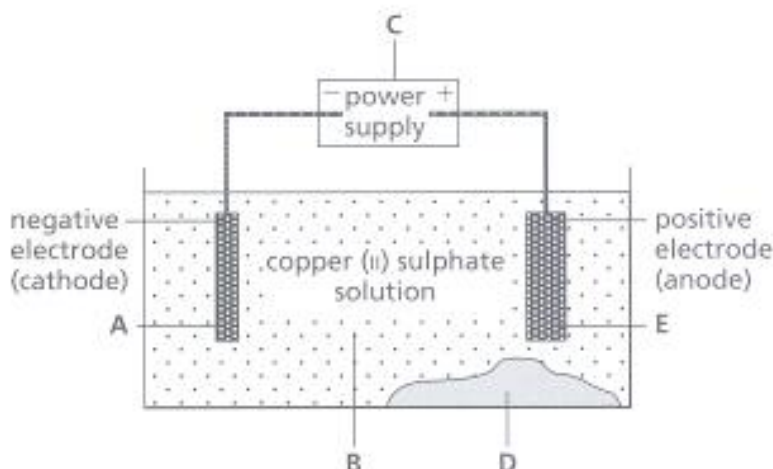
- (i) How many faradays are needed to deposit 1 mole of silver? (1)

(ii) How many coulombs are needed to deposit 0.108 g of silver? You must show how you work out your answer. (1 faraday = 96000 coulombs; relative atomic mass: Ag =108.) (2)

(iii) For how long must a constant current of 0.1 A pass through the cell to deposit 0.108 g of silver? You must show how you work out your answer. (2)

(OCR, GCSE, Paper 4, June 2000)

31a. The diagram shows a method for obtaining pure copper from impure copper.

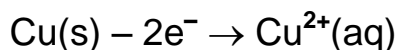


State the place, A, B, C, D or E, where:

- (i) the impure copper is placed
- (ii) the solid impurities collect
- (iii) the pure copper forms. (3)

b. A data book may help you to answer this question. The solid impurities from this process contain silver. Why does silver not react with the copper (II) sulphate solution? (1)

c. One of the reactions which takes place in this process is represented by the equation.



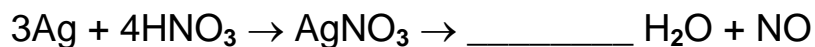
Why is this reaction described as oxidation? (1)

d. Copper and silver conduct electricity. Explain, in terms of particles, why they are good conductors of electricity. (3)

e. Silver is changed into silver chloride in two stages.

(i) In Stage 1 silver is reacted with nitric acid to make silver nitrate, water and nitrogen oxide (NO). Copy and balance the symbol equation for this

reaction. (1)



(ii) Copy and complete the word equation for Stage 2. (1)

silver nitrate + _____ \rightarrow silver chloride + sodium nitrate

f. Photographic film can be made by coating paper with silver chloride. Explain what happens to the silver chloride when the film is exposed to light. (2)

(AQA, GCSE, Paper 2372, June 2000)

32a. The relative molecular mass (M_r) of sodium hydroxide, NaOH, is 40. If 8.0 g of sodium hydroxide are present in 1000 cm³ (1 dm³) of aqueous solution

(i) What is the concentration of this solution in mol dm⁻³? (1)

(ii) How many moles would be present in 25 cm³ of the sodium hydroxide solution? (2)

b. Ethanoic acid, CH₃COOH, and sodium hydroxide react in a 1 : 1 ratio. When ethanoic acid was neutralised by sodium hydroxide solution, it was found that 25 cm³ of the sodium hydroxide solution required 20 cm³ of ethanoic acid solution.

(i) How many moles of ethanoic acid are present in 20 cm³ of ethanoic acid solution? (1)

(ii) How many moles would be present in 1 dm³ of ethanoic acid solution? (2)

c. If the relative molecular mass (M_r) of ethanoic acid is 60, calculate the number of grams of ethanoic acid present in 1 dm³ of the solution. (2)

(WJEC, GCSE, June 2000)

33. Methyl orange and phenolphthalein are two useful indicators in the laboratory. They change colour when they are mixed with acids or alkalis.

Indicator	Colour in acid	Colour in neutral solution	Colour in alkali
Methyl orange	Pink	Yellow	Yellow
Phenolphthalein	Colourless	Colourless	Red

a. Using the table above, copy and fill in the gaps in the following table. (4)

Aqueous solution	Colour of solution in methyl orange	the presence of phenolphthalein
Hydrogen chloride		
Ammonia		
Sodium chloride		
Sulphur dioxide		

b. A solution is made up by mixing 25 cm^3 of NaOH(aq) with 15 cm^3 of $\text{H}_2\text{SO}_4\text{(aq)}$. Three drops of methyl orange indicator are added. The NaOH(aq) and $\text{H}_2\text{SO}_4\text{(aq)}$ were of equal concentration before addition. What colour would you expect for the resultant solution? (1)

c. Would the indicators above be suitable to decide if a solution of bromine in water is acidic, neutral or alkaline? Explain your answer. (3)

d. Copper nitrate, a blue crystalline solid, may be obtained by reacting copper carbonate with dilute nitric acid and crystallising the resulting solution. The following method is often followed:

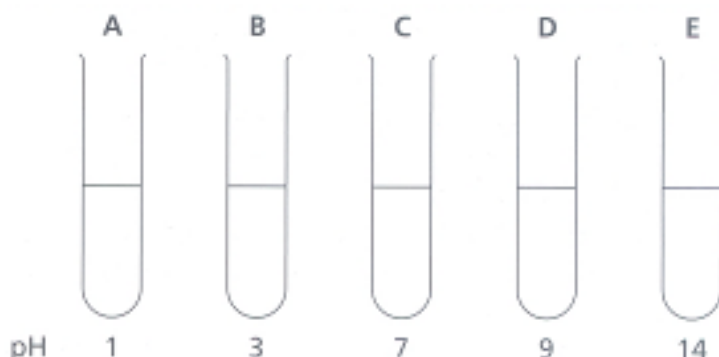
50 cm^3 of nitric acid, concentration 1 mol/dm^3 (moles per litre) are placed in a 250 cm^3 beaker and copper carbonate is added with stirring until no further reaction takes place. The mixture is filtered into an evaporating basin and the solution reduced to about 3 in volume by evaporation. The liquid is left to cool until blue crystals have formed. The crystals are filtered off, washed with a little cold water and dried between filter papers. Finally the crystals are weighed.

(i) Write a balanced, symbol equation for the reaction. (2)

- (ii) How would you know when the reaction had finished? (1)
- (iii) What was the purpose of the first filtration? (2)
- (iv) Why was the final filtrate not evaporated to dryness? (1)
- (v) In an experiment to make copper nitrate a student obtained 5.50 g of crystals. Calculations show that 6.05 g of crystals could have been obtained from the amounts of the starting materials which were used. Suggest two reasons why the student did not obtain the full 6.05 g of crystals. (2)

(CCEA, GCSE, Paper 2, June 2000)

34a. Five solutions, A-E, were tested with universal indicator solution, to find their pH. The results are shown below.



(i) The five solutions were known to be ammonia solution, potassium hydroxide, sodium chloride, sulphuric acid and vinegar. Identify each of the solutions A-E. (5)

(ii) Give a balanced symbol equation for the reaction which occurs when solutions A and D are mixed. (2)

b. Complete the following passage by inserting the correct words/formulae in the spaces.

Acids are compounds which dissolve in water producing (i) _____ ions which have formula (ii) _____.

Alkalis are compounds which dissolve in water producing (iii) _____ ions which have formula (iv) _____.

The ionic equation for the reaction which takes place on mixing acids and alkalis is (v) _____ . (6)

c. Describe in detail how you would prepare a pure dry sample of sodium chloride crystals in the laboratory starting with solutions of sodium hydroxide and hydrochloric acid. (8)

d. (i) Describe a test which you would use to confirm the presence of sodium ions in a sample of the salt prepared in part c. (3)

(ii) Describe a test which you would use to confirm the presence of chloride

ions in a sample of the salt prepared in part c.

(4)

(CCEA, GCSE, Paper 2, June 1999)

35a. Aluminium hydroxide reacts with both acids and alkalis. Give balanced symbol equations for the following reactions of aluminium hydroxide

- (i) with dilute hydrochloric acid (2)
- (ii) with sodium hydroxide solution. (2)

b. Sodium hydroxide solution is added in excess to a green solution of a metal salt. A green precipitate is observed which slowly turns reddish-brown on leaving exposed to air.

- (i) Identify the metal ion present in the original green solution. (1)
- (ii) Explain why the green precipitate changed colour. (3)

(CCEA, GCSE, Paper 2, June 1999)

36a. The following table shows the colours of universal indicator at different pH values.

Colour	Red	Orange	Yellow	Green	Blue	Navy blue	Purple
pH	0-2	3-4	5-6	7	8-9	10-12	13-14

(i) Sodium carbonate solution turns universal indicator navy blue. Give the pH range of this solution. (1)

(ii) The pH of hydrochloric acid solution is 1. Give the colour universal indicator would turn in hydrochloric acid solution. (1)

b. (i) Name the colourless solution and colourless gas formed when sodium carbonate reacts with dilute hydrochloric acid. (2)

(ii) Describe a test you would carry out to identify the gas formed. (1)

(iii) What would you see if the gas was present? (1)

(WJEC, GCSE, June 2000)

37a. The solubility of a solid in water changes as the temperature changes. What do you understand by the term 'solubility'? (4)

b. A student investigates the solubility of two different solids at various temperatures. The table that follows shows the results obtained.

Temperature/°C	Solubility of solid/g/100g water	
	Sodium chloride	Potassium chlorate
0	33.0	3.5
20	33.5	7.5
40	34.0	14.0
60	34.5	24.0
80	35.0	37.5

(i) Plot the results for the two different solids on graph paper. (8)

(ii) Compare the effect of increasing the temperature on the solubility of each solid. (2)

(iii) At which temperature are the solubilities of the two solids the same? (1)

(iv) What is the solubility of the two solids at the temperature in part (iii)? (1)

(v) If a saturated solution of potassium chlorate containing 50 g of water is cooled from 70°C to 30°C, what mass of the solid would crystallise? (4)

(vi) If a solution is made by dissolving 15 g of each solid in the same 100 g of water at 70°C and the solution is cooled to 20°C, crystals are observed. Which solid crystallises? Explain your answer with reference to both solids. (4)

(CCEA, GCSE, Paper 1, June 2000)

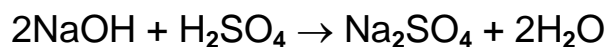
38. To obtain full marks the steps in the calculations must be shown.

A series of experiments was carried out on a given solution of sulphuric acid.

a. In the first of these experiments a titration was carried out to determine the concentration of the acid. 20.0 cm^3 of the acid required 32.0 cm^3 of 0.15 moles per litre (mol/dm^3) sodium hydroxide solution.

(i) Calculate the number of moles of sodium hydroxide used in the titration. (2)

The equation of the titration reaction is



(ii) Calculate the number of moles of H_2SO_4 titrated. (3)

(iii) Calculate the concentration of the sulphuric acid used in moles per litre (mol/dm^3). (2)

b. In a second experiment, a group of pupils proceeded to make nickel sulphate crystals by adding an excess of nickel carbonate to 50.0 cm^3 of the same sulphuric acid. The equation for the reaction is:



(i) Calculate the number of moles of sulphuric acid used. (2)

(ii) What is the minimum mass of NiCO_3 which must be used to react with all the sulphuric acid? ($\text{Ni} = 59$, $\text{C} = 12$, $\text{O} = 16$) (4)

(iii) Nickel sulphate crystallises as $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$. What is the maximum mass of crystals which could be obtained from this preparation. ($\text{Ni} = 59$, $\text{S} = 32$, $\text{O} = 16$, $\text{H} = 1$) (4)

(iv) At the end of the experiment, one student collected 1.20 g of crystals. Suggest one reason why the mass collected was less than that calculated in part b (iii) above. (1)

c. A possible way to make ammonium sulphate is to react ammonia gas

with sulphuric acid.

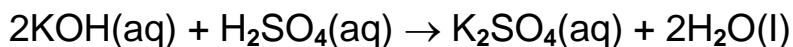
If 25.0 cm³ of the sulphuric acid from part a were used, what volume, in cm³, of ammonia gas would be needed to react exactly with the acid. (1 mole of any gas occupies 24 dm³ at room temperature.)

The equation for the reaction is



(CCEA, GCSE, Paper 1, June 1999)

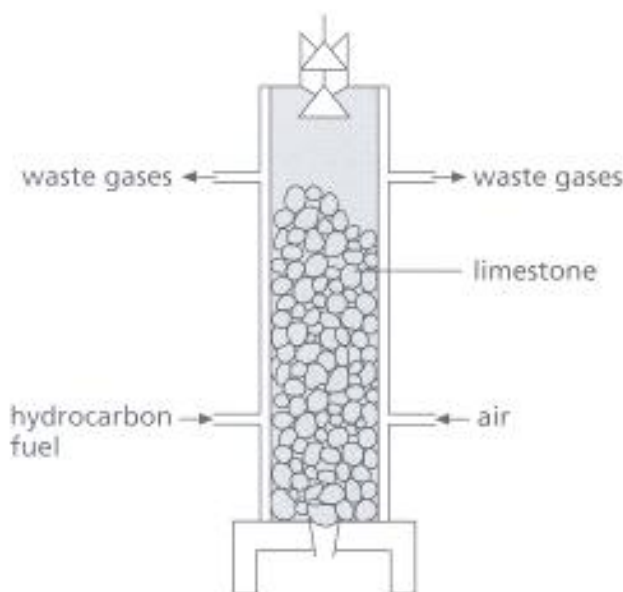
39. A student carried out a titration to find the concentration of a solution of sulphuric acid. 25.0 cm³ of the sulphuric acid solution was neutralised exactly by 34.0 cm³ of a potassium hydroxide solution of concentration 2.0mol/dm³. The equation for the reaction is:



- a. Describe the experimental procedure for the titration carried out by the student. (4)
- b Calculate the number of moles of potassium hydroxide used. (2)
- c Calculate the concentration of the sulphuric acid in mol/dm³. (3)

(SEG, GCSE, Paper 5, Summer 2000)

40. Limestone is a useful mineral. Every day, large amounts of limestone are heated in limekilns to produce lime. Lime is used in the manufacture of iron, cement and glass and for neutralising acidic soils.



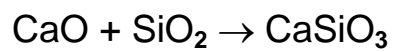
a. (i) The decomposition of limestone is a reversible reaction. Explain what this means. (2)

(ii) Calculate the mass of lime, CaO, that would be produced from 250 tonnes of limestone, CaCO₃. (Relative atomic masses: C 12; O 16; Ca 40.) (3)

b. Large amounts of carbon dioxide are produced when using limekilns, both from burning hydrocarbons to provide heat and from the decomposition of the limestone.

Give two ways by which carbon dioxide is removed naturally from the atmosphere. (2)

c. Limestone is added to the blast furnace during the extraction of iron. The lime formed reacts as shown by the equation.



Describe and explain the importance of this reaction in the blast furnace.(3)

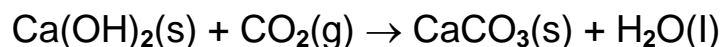
(SEG, GCSE, Paper 6/4, Summer 2000)

41a. (i) Cement is an important building material. Describe how cement is made. (3)

(ii) When cement is mixed with water, sand and crushed rock, a slow chemical reaction takes place which produces another important building material. Name this important building material. (1)

b. Mortar is used to hold bricks and stonework in position. It is a much older building material than cement and has been used since Roman times. Mortar is made by mixing calcium hydroxide (slaked lime), sand and water into a paste. Mortar hardens over many years on standing in air. This is due to two processes.

- The water evaporates.
- The slaked lime reacts slowly with carbon dioxide in the air to form calcium carbonate.



(i) Suggest why the calcium carbonate forms very slowly. (1)

(ii) Use your answer to part b (i) and a data book to help you answer this question.

An archaeologist found two pieces of mortar. One piece was very old and from a Roman villa built about AD 300. The other piece was from a modern cottage built in 1995.

Describe and give the result of an experiment the archaeologist could do which would prove that one of the pieces of mortar was much older than the other piece. (3)

(iii) The outer layer of mortar slowly changes. The calcium carbonate reacts with carbon dioxide and water in the air to form calcium hydrogencarbonate.

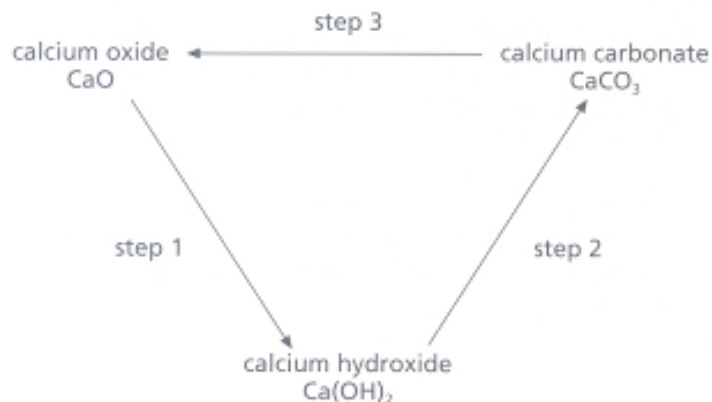


Rainwater removes the calcium hydrogencarbonate from between the bricks. The gaps then need to be filled in (pointed) with new mortar or

cement. Use the equation to suggest why calcium hydrogencarbonate is easily removed by rainwater. (1)

(AQA, GCSE, Paper 2372, June 2000)

42. The diagram shows three calcium compounds.



a. (i) Which compound occurs widely in nature? (1)

(ii) Which compound is present in solution in limewater? (1)

(iii) What state symbol is used to show limewater is a solution? (1)

(iv) Which compound is formed on boiling temporary hard water? (1)

(v) What is added to calcium oxide to carry out step 1? (1)

(vi) How can step 3 be carried out? (1)

(vii) Which step occurs during the test for carbon dioxide? (1)

b. Two different white powders are thought to be calcium carbonate and calcium hydroxide.

(i) Describe a test to prove that both powders are calcium compounds. (2)

(ii) Describe a test to find out which one of the powders is calcium carbonate. (2)

(Edexcel, GCSE, Paper 2F, June 2000)

43. Analysis of a water supply produced the following data.

Analysis		
Ion		Concentration in mg per dm ³
Calcium	(Ca ²⁺)	104.0
Magnesium	(Mg ²⁺)	1.4
Sodium	(Na ⁺)	8.0
Potassium	(K ⁺)	1.0
Iron	(Fe ³⁺)	0.02
Hydrogencarbonate	(HCO ₃ ⁻)	293.0
Chloride	(Cl ⁻)	15.0
Sulphate	(SO ₄ ²⁻)	12.0
Nitrate	(NO ₃ ⁻)	5.0
Fluoride	(F ⁻)	0.1

a. (i) Which two elements in this water supply are in Group 2 of the periodic table? (1)

(ii) Write down the name of a transition metal which is present in this water supply. (1)

(iii) Write down the names of two ions in this water supply which can combine together to form a compound of formula XY₂ where X is a metal. (2)

b. Sana tests for the ions found in this water supply. She concentrates the ions by evaporating some of the water before doing the tests. Finish the table. There are four gaps.

Test	What is seen	Ion present
Add dilute hydrochloric acid. Test the gas given off with limewater.	It fizzes, and the gas given off turns the limewater (i) _____ .	HCO ₃ (1)
Add dilute nitric acid and silver nitrate solution.	A white precipitate is formed.	(ii) _____ (1)

Add dilute nitric acid and barium chloride solution.	A (iii) _____ precipitate is formed.	SO_4^{2-} (2)
Add sodium hydroxide solution.	A brown precipitate is formed.	(iv) _____ (2)

c. A hospital process has to let 30 dm^3 of water flow through pipes in 24 hours. If more than 120 mg per hour of calcium flows through the pipes, the process becomes damaged.

Decide whether this water supply is suitable for use in the process. You must show how you work out your answer. (2)

d. All the hardness in this water has to be removed before the water is used in a steam-iron. Which two of these methods could be used successfully? (2)

- A. Boil the water, cool it and then filter it.
- B. Distil the water.
- C. Trickle the water down a zeolite ion-exchange column.
- D. Treat the water with calcium hydroxide then filter it.

e. Glyn always makes tea using this water supply. He boils the water in an electric kettle. Describe and explain the problem caused by the frequent use of this water supply in the kettle. (3)

(OCR, GCSE, Paper 4, June 2000)

44. A sample of tap water contains the following dissolved salts:

calcium hydrogencarbonate
calcium sulphate
magnesium sulphate
potassium chloride
sodium chloride

a.(i) Hard water can be formed when water is in contact with the rock, gypsum. Which salt in the list is present in gypsum? (1)

(ii) Name two other salts in the list which make water hard. (2)

b. Some methods of treating water are given below.

- A. adding chlorine
- B. adding a fluoride (fluoridation)
- C. adding sodium carbonate
- D. boiling the water

Which one of the methods (A, B, C or D) removes:

(i) temporary hardness but not permanent hardness? (1)

(ii) both temporary hardness and permanent hardness? (1)

c. Ten drops of soap solution are shaken with a sample of hard tap water. The mixture turns cloudy but it does not form a lather. On shaking with ten more drops of soap solution, a lather is formed.

(i) What causes the cloudiness when soap solution is first mixed with this tap water? (1)

(ii) Predict what you would see when distilled water is shaken with ten drops of soap solution. Explain your answer. (2)

d. Calcium hydrogencarbonate is formed when water and carbon dioxide are in contact with limestone. This reaction removes carbon dioxide gas from the atmosphere.

(i) Write the word equation for this reaction. (1)

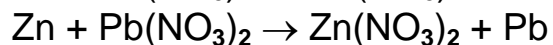
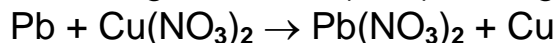
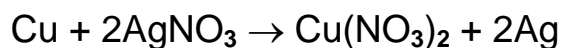
(ii) Plants are also able to remove carbon dioxide from the atmosphere, forming glucose and oxygen gas in the process.

Give the name of this process and state one essential condition needed for it to take place. (2)

e. If the percentage of carbon dioxide in the Earth's atmosphere increases, the average temperature of the atmosphere may also increase. What is the name given to this effect? (1)

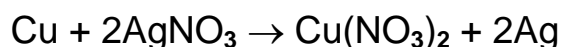
(Edexcel, GCSE, Paper 2F, June 2000)

45. The equations show three displacement reactions involving metals and solutions of metal nitrates.



a.(i) Use this information to find the order of reactivity of the four metals, with the most reactive first. (1)

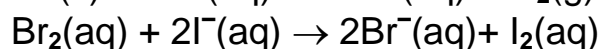
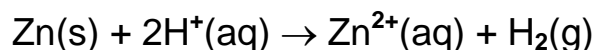
(ii) Calculate the mass of copper needed to displace 5.0 g of silver from silver nitrate solution.



(Relative atomic masses: Ag = 108, Cu = 63.5.) (3)

(iii) Write an equation, including state symbols, for the reaction between lead and aqueous silver nitrate. (3)

b. Zinc and bromine undergo displacement reactions as shown by the equations below. Zinc is oxidised and bromine is reduced during these reactions.



(i) Name one compound containing H⁺ ions and another containing I⁻ ions, which would be suitable for these reactions. (2)

(ii) Explain why zinc is said to be oxidised in its reaction. (1)

(iii) Complete the half equation to show the oxidising action of bromine.



(Edexcel, GCSE, Paper 3H, June 1999)

46. The use of most metals depends on their reactivity.

a. Reactivity of metals can be compared by using displacement reactions. The reactions of four metals R, S, T and U with their salt solutions are shown. (These letters are not the chemical symbols for the metals.)

Metal salt solution	Metal			
	R	S	T	U
R		X	X	✓
S	✓		X	✓
T	✓			✓
U	X	X	X	

✓ = reaction X = no reaction

(i) Use the information to arrange the metals R, S, T and U in order of reactivity, with the most reactive first. (2)

(ii) Metal R was zinc and metal T was copper. State what causes the colour changes that you see when zinc reacts with copper sulphate solution. (3)

(SEG, GCSE, Paper 6/4, June 1999)

47. By observing the reactions of metals with water and dilute sulphuric acid it is possible to put metals in order of their reactivity.

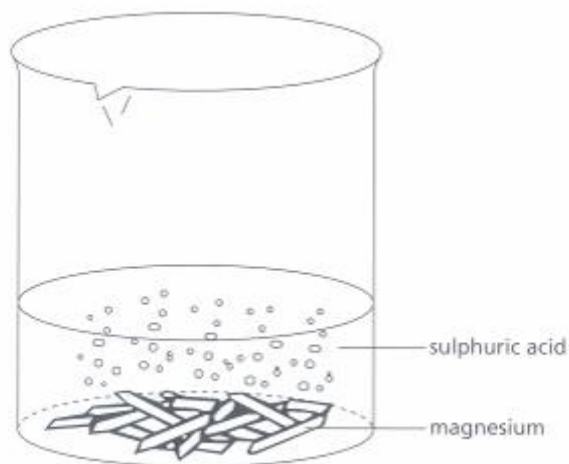
a. A, B, C and D represent four metals.

Metal	Reaction with water	Reaction with dilute sulphuric acid
A	No reaction	Reacts slowly at first
B	No reaction	No reaction
C	Little or no reaction	Reacts quickly
D	Vigorous reaction	Violent - dangerous reaction

(i) Put metals A, B, C and D in order of their reactivity with the most reactive first. (2)

(ii) The metals used were copper, magnesium, sodium and zinc. Use the information in the table to identify which of these metals was A, B, C and D. (2)

b. A student tried to make some magnesium sulphate. Excess magnesium was added to dilute sulphuric acid. During this reaction fizzing was observed due to the production of a gas.



(i) Copy, complete and balance the chemical equation for this reaction.



(ii) At the end of the reaction the solution remaining was filtered. Why was

the solution filtered?

(1)

(iii) The filtered solution was left in a warm place.



Explain why the filtered solution was left in a warm place.

(2)

(SEG, GCSE, Paper 6/4, Summer 2000)

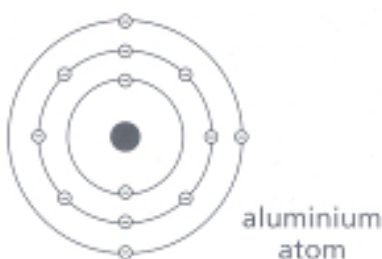
48. Most of the cans used for drinks are made from aluminium.



a.(i) Aluminium is an element. What does this mean? (1)

(ii) Metals are malleable and this makes them suitable to make drinks cans. What does malleable mean? (1)

b. The arrangement of electrons in an aluminium atom is:



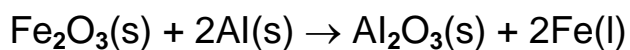
(i) On the diagram label the nucleus of the aluminium atom. (1)

(ii) How many protons does an aluminium atom have? (1)

(iii) To which group of the periodic table does aluminium belong? (1)

(iv) To which period of the periodic table does aluminium belong? (1)

c. The reaction between aluminium and iron oxide is used to join lengths of railway track. It is called the thermit reaction.



- (i) Why does aluminium react with iron oxide? (1)
- (ii) What does the (l) after Fe in the chemical equation mean? (1)
- (iii) Suggest why the thermit reaction can be used to join lengths of railway track. (2)

(SEG, GCSE, Paper 6/4, June 1999)

49a. Describe how steel is manufactured using molten iron obtained from the blast furnace. Your answer should include:

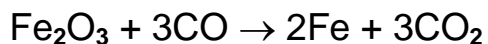
- the types of reaction occurring;
- the details of the conditions used;
- energy changes involved. (5)

b. Suggest two factors which influence the location of plants associated with the manufacture of steel. (2)

c. Give two reasons why it is important to recycle steel. (2)

(AQA, GCSE, Paper 2372, June 2000)

50a. Iron is extracted from iron(III) oxide in a blast furnace. One of the main reactions in the furnace is



(Relative atomic mass: $A_r(\text{O}) = 16$; $A_r(\text{Fe}) = 56$.)

(i) Calculate the relative molecular mass (M_r) of iron (III) oxide, Fe_2O_3 . (2)

(ii) Use the given equation for the extraction of iron to calculate how many tonnes of metal could be obtained from 80 tonnes of iron (III) oxide. (3)

b. 14.4 g of another oxide of iron was found to contain 11.2 g of iron. Calculate the simplest formula for this oxide of iron. Show your working.

(Relative atomic mass: $A_r(\text{O}) = 16$; $A_r(\text{Fe}) = 56$.) (3)

c. Iron (II) and iron (III) salts in solution form different coloured precipitates with sodium hydroxide solution.

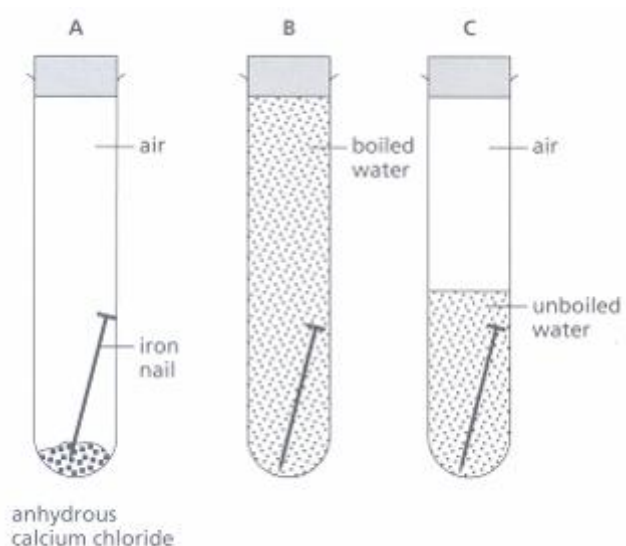
State the colour of the precipitate formed with

(i) iron (II) salts

(ii) iron (III) salts. (2)

(WJEC, GCSE, 0125/2, June 1999)

51a. Three test-tubes were set up as shown to investigate the rusting of iron. After one week rusting was observed in tube C but not in tubes A and B.



(i) Why is anhydrous calcium chloride placed in tube A? (1)

(ii) Why is the water in tube B boiled? (2)

(iii) What would you expect to happen to the nail in tube B if the stopper was removed and the tube left for a further week? (1)

(iv) From the results of the above experiments state the conditions necessary for the rusting of iron. (2)

b. Rusting may be prevented using a variety of methods. Which method is normally used to protect the following from rusting?

(i) School railings

(ii) Garden tools

(iii) Bicycle handlebars

(iv) Scissor blades (4)

c. Underground pipes made from steel are protected from rusting by

attaching bars of magnesium to the pipes.

(i) Give the name of this type of protection. (1)

(ii) Explain why magnesium is used. (2)

(iii) Name two other metals which could be used to protect the iron instead of magnesium. (2)

d. Many foods are packed in 'tin' cans which are made from steel coated with a fine layer of tin.

(i) Give two reasons why the cans are coated with tin. (2)

(ii) The tin is deposited on the steel in a process called _____ (1)

e. Ordinary steel exhaust systems rust much faster than any other part of a car. Explain this observation. (3)

f. What is the chemical name for rust? (2)

g. Is rusting of iron an oxidation or reduction process? Explain your answer in terms of electrons. (3)

(CCEA, GCSE, Paper 1, June 1999)

52a. The transition elements have the typical properties of metals.

(i) Transition metals are good conductors of electricity. Explain why. (2)

(ii) Transition metals have high melting points. Explain why. (2)

b. Iron is a transition metal. Iron, because of its strength, is used in the building of ships' hulls. The main problem of using iron is that it rusts unless protected.

(i) Explain how painting stops an iron hull from rusting. (2)

(ii) Explain how attaching zinc blocks to an iron hull stops it from rusting. (2)

(SEG, GCSE, Paper 6/4, June 1999)

53. This question is about the composition of the atmosphere.

a. Copy and finish the table to show the composition of the atmosphere.

Use all the names from the list.

- argon
 - nitrogen
 - carbon
 - dioxide oxygen
- (3)

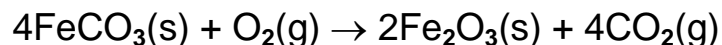
About 80%	About 20%	Traces

b. Millions of years ago the atmosphere of the Earth had a different composition.

(i) How have the amounts of carbon dioxide and oxygen changed since then? (1)

(ii) Suggest how the evolution of plants has helped to produce the present composition of the atmosphere. (3)

c. The composition of the atmosphere is also affected by the weathering of vast amounts of igneous rocks containing iron compounds. Some of the iron compounds are changed into iron (II) carbonate. This is readily oxidised, on contact with air, to form iron (III) oxide. The equation for this reaction can be represented by



How does this process affect the composition of the atmosphere? (2)

(OCR, GCSE, Paper 2, June 1999)

54. For 200 million years the proportions of the different gases in the atmosphere have been much the same as they are today.

Over the past 150 years the amount of carbon dioxide in the atmosphere has increased from 0.03% to 0.04%.

a. Describe how carbon dioxide is released into the atmosphere

(i) by human and industrial activity (2)

(ii) from carbonate rocks by geological activity. (2)

b. Explain how the seas and oceans can decrease the amount of carbon dioxide in the atmosphere. (3)

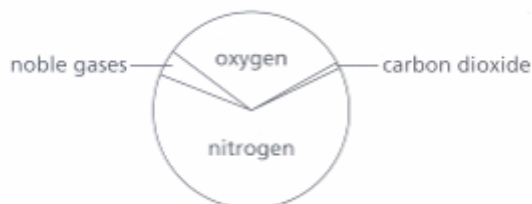
c.(i) Give one reason why the amount of carbon dioxide in the atmosphere is increasing gradually. (1)

(ii) Give one effect that increasing levels of carbon dioxide in the atmosphere may have on the environment. (1)

(AQA, GCSE, Paper 2372, June 1999)

55a. The main components of the original Earth's atmosphere were carbon dioxide and water. The pie chart below shows the approximate composition of dry air in the atmosphere today.

(i) State the source of the original Earth's atmosphere. (1)



(ii) Name the gas in the pie chart which is entirely biological in origin. (1)

(iii) There has been a drastic reduction in the amount of water vapour in the air over geological time. Explain how this decrease occurred. (2)

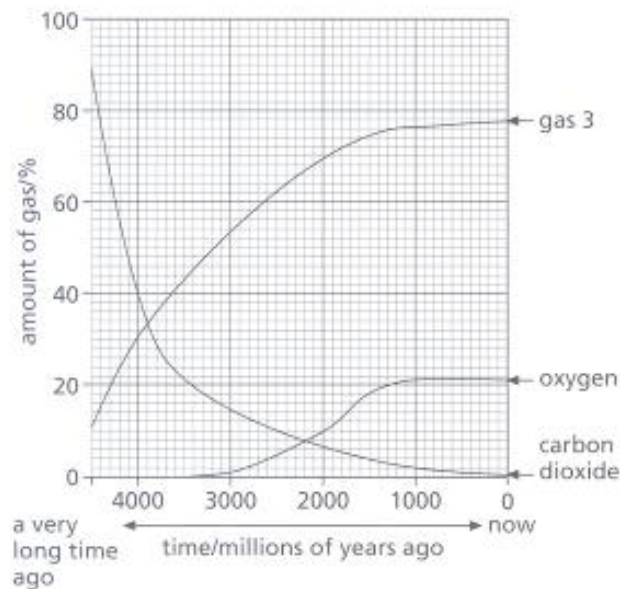
b. The Earth's atmosphere is surrounded by a layer of ozone. State the importance of the ozone layer to our health. (1)

c. Give one use to which oxygen is put. (1)

d. The carbon cycle helps to maintain atmospheric composition. Name two processes which have the opposite effect to photosynthesis in the carbon cycle. (2)

(WJEC, GCSE, June 2000)

56. This graph shows how we think the amounts of gases in our atmosphere have changed over millions of years.



a. The first plants appeared on Earth 3000 million years ago.

(i) What happened to the amount of oxygen after the plants appeared? (1)

(ii) After animals appeared on Earth the amount of oxygen stayed the same. When did land animals appear? (1)

b. Describe how the amount of carbon dioxide has changed. (2)

c. Scientists think the amount of carbon dioxide in the atmosphere has been increasing for the last 200 years. What environmental problem could this cause? (1)

d. There is another gas on the graph, labelled 'gas 3'.

(i) How much of 'gas 3' is in our atmosphere today? (1)

(ii) What is the name of this gas? (1)

(OCR, GCSE, Paper 1, June 2000)

57a. Water is essential for life. Two of the stages involved in the treatment of public water supplies are the use of filter beds and chlorination.

State the purpose of

(i) filter beds (1)

(ii) chlorination. (1)

b. Describe how you would show that a colourless liquid is pure water. Include in your answer the result you would expect. (2)

c.(i) A small amount of soap solution was added to samples of soft water and hard water and the mixtures were shaken. How would you identify the hard water? (1)

(ii) What is dissolved in water which makes it hard? (1)

(iii) Give one advantage of hard water. (1)

(iv) Give one method of softening hard water other than by boiling. (1)

(WJEC, GCSE, June 2000)

58. Sue studied the reaction between calcium carbonate and hydrochloric acid. The equation for this reaction is

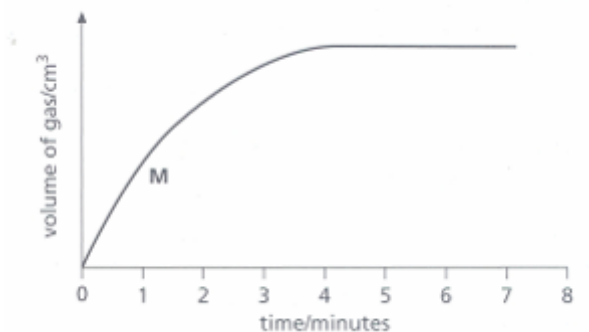


Sue carried out three experiments to study the effect of the surface area of the calcium carbonate. She used calcium carbonate in the form of small lumps or medium lumps or large lumps. In each experiment she used the same mass of calcium carbonate. She measured the volume of gas collected in a gas syringe at intervals.

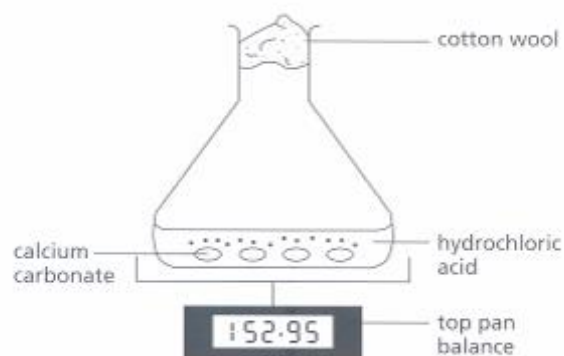
a. Write down two other things she should keep the same in each experiment. (2)

b. In each experiment all the calcium carbonate had reacted within five minutes. Sue's graph line for medium lumps is shown on the grid.

Copy the graph and sketch graph lines for small lumps and large lumps. Label your lines S for small lumps and L for large lumps. (3)



c. Sue measured the rate of this reaction in a different way. This is the apparatus she used.



(i) How could she use measurements of mass to follow the rate of reaction? (2)

(ii) Why did she put cotton wool in the neck of the flask? (1)

(OCR, GCSE, Paper 2, June 1999)

59. This item appeared in the Wolverhampton Express & Star on October 31st, 1997.

Fumes scare at factory

Workers were forced to flee a factory after a chemical alert.

The building was evacuated when a toxic gas filled the factory.

It happened when nitric acid spilled on to the floor and mixed with magnesium metal powder.

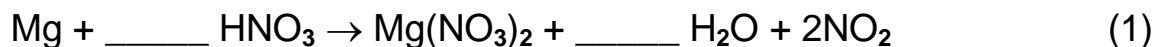
Read the passage and answer the questions that follow.

a. Explain, in terms of particles, how the toxic gas was able to fill the factory quickly. (2)

b. The reaction of nitric acid with magnesium metal powder is more dangerous than if the acid had fallen on to the same mass of magnesium bars. Explain why. (1)

c. Water was sprayed on to the magnesium and nitric acid to slow down the reaction. Explain, in terms of particles, why the reaction would slow down. (2)

d.(i) Copy and balance the equation for the reaction between magnesium and nitric acid:



(ii) The toxic gas was nitrogen dioxide, NO_2 . Calculate the mass of nitrogen dioxide produced when 96 g of magnesium reacts completely with nitric acid.

(Relative atomic masses: N = 14, O = 16, Mg = 24.)

(3)

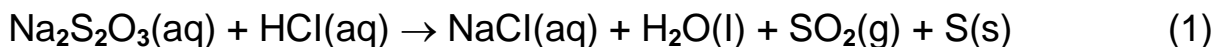
(AQA, GCSE, Paper 2372, June 1999)

60. A student studied the effect of temperature on the rate of reaction between hydrochloric acid and sodium thiosulphate.



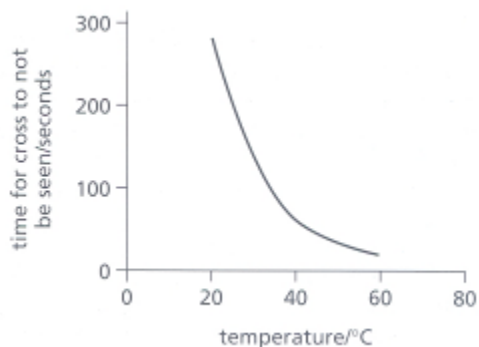
- The student mixed 50 cm³ of a sodium thiosulphate solution and 5cm³ of hydrochloric acid in a flask.
- The flask was placed over a cross.
- The student timed how long after mixing the cross could no longer be seen.

a.(i) Balance the chemical equation for this reaction.



(ii) What causes the cross to be seen no longer? (1)

b. A graph of the results is shown.

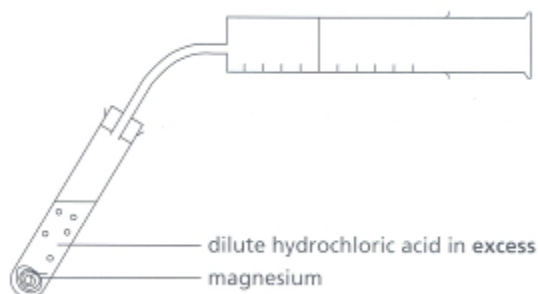


(i) What effect does temperature have on the rate of this reaction? (1)

(ii) Explain why temperature has this effect on the rate of reaction. (2)

(SEG, GCSE, Paper 6/4, Summer 2000)

61. Magnesium ribbon was reacted with excess dilute hydrochloric acid to produce hydrogen gas. The volume of hydrogen produced in the reaction was measured using a gas syringe. The experiment was carried out at a temperature of 20°C.



The table below shows the results obtained in the experiment.

One of the results is unreliable.

Time/ seconds	0	10	20	30	40	50	60	70
Volume of gas/cm ³	0	50	80	100	102	118	120	120

a. Plot the data on graph paper and draw a smooth curve through the reliable points. (3)

b. Sketch carefully on the grid the graph that would have been obtained if

(i) the same experiment was repeated at 40°C. Label this graph B. (2)

(ii) the magnesium ribbon had been replaced by a piece half as long and reacted with the same acid, which is still in excess. Label this graph C. (2)

c. State and explain, using particle theory, what would happen to the rate if a higher concentration of acid than in the original experiment was used. (2)

(WJEC, GCSE, 0125/2, June 1999)

62. Hydrogen peroxide, H_2O_2 , is often used as a bleach. It decomposes forming water and oxygen.

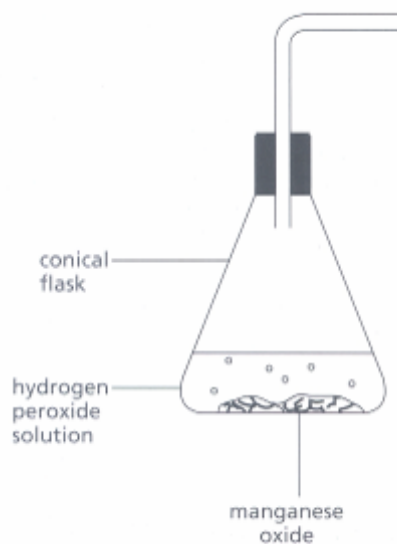
a.(i) Write the balanced chemical equation for the decomposition of hydrogen peroxide. (3)

(ii) Give a test for oxygen, and the result for that test. (2)

b. The rate of decomposition of hydrogen peroxide at room temperature is very slow. Manganese oxide is a catalyst which can be used to speed up the decomposition. Copy and complete the sentence. A catalyst is a substance which speeds up a chemical reaction. At the end of the reaction, the catalyst is _____ . (1)

c. Two experiments were carried out to test if the amount of manganese oxide, MnO_2 , affected the rate at which the hydrogen peroxide decomposed.

(i) Copy and complete the diagram to show how you could measure the volume of oxygen formed during the decomposition. (2)

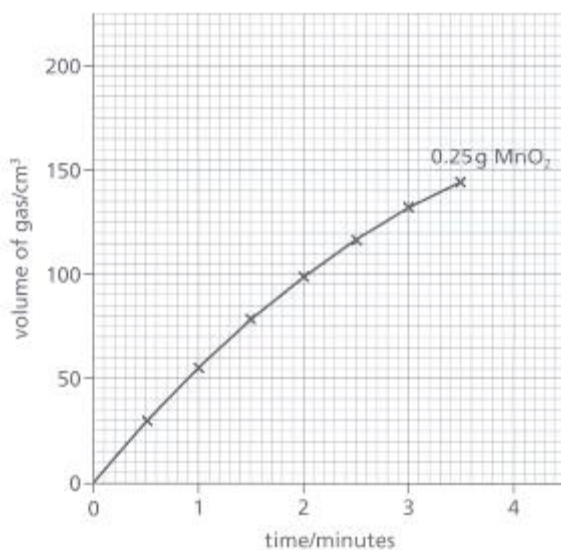


(ii) The results are shown in the table.

Time (min)	0	0.5	1	1.5	2	2.5	3	3.5
Volume of gas,	0	29	55	77	98	116	132	144

using 0.25 g MnO_2 (cm^3)								
Volume of gas, using 2.5 g MnO_2 (cm^3)								

Copy the grid and draw a graph of these results. The graph for 0.25 g MnO_2 has been drawn for you.



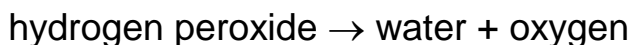
(iii) Explain why the slopes of the graphs become less steep during the reaction. (2)

(iv) The same volume and concentration of hydrogen peroxide solution was used for both experiments. What two other factors must be kept the same to make it a fair test? (2)

(SEG, GCSE, Paper 6/4, June 1999)

63. This question is about catalase, an enzyme in vegetables.

Catalase acts as a catalyst for the splitting up of hydrogen peroxide.



a. Sam does an experiment at 20°C. She uses 25 cm³ of hydrogen peroxide solution and 1 cm³ of catalase solution. She measures the volume of gas given off each minute for five minutes. The table shows her results.

Time/min	0	1	2	3	4	5
Volume of gas/cm ³	0	25	40	53	50	50

(i) On a piece of graph paper, label and choose the best scale for the vertical axis. (1)

(ii) Plot the points on the grid. (1)

(iii) Finish the graph by drawing the curve of best fit. (1)

(iv) Sam does the experiment again but this time at 30°C. Draw, on the same grid, the graph she would expect to get. (2)



b. The strength of a hydrogen peroxide solution is sometimes given as 'volume strength'. A 10-volume solution produces 10 cm^3 of oxygen for each 1 cm^3 of solution used.

What is the 'volume strength' of the hydrogen peroxide Sam used? (1)
(OCR, GCSE, Paper 2, June 1999)

64a. Petrol is a fossil fuel and so its supply is limited. Alternative fuels will be needed as it runs out. The table shows data from 1998 for petrol and some alternative fuels.

Fuel	Cost of 100g/pence	Energy per 100g/kJ	Energy per penny/kJ
Petrol	6.8	4800	706
Diesel oil	6.4	4700	734
Ethanol	8.5	2900	341
Hydrogen	20.0	14300	715
Vegetable oil	9.0	3800	422

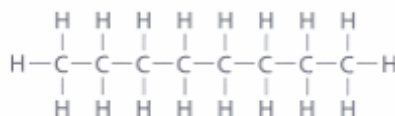
(i) Use the data in the table to explain why diesel oil seems to be a good alternative to petrol. (1)

(ii) From your knowledge of fuels, give one disadvantage of using diesel oil as a replacement fuel for petrol. (1)

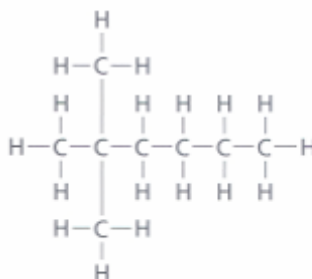
(iii) From the table, hydrogen seems to be a good alternative to petrol. Suggest one advantage and two disadvantages of using hydrogen as a fuel for cars. (3)

b. Petrol is a mixture of hydrocarbons. There are several compounds in petrol which have the molecular formula C_8H_{18} .

Name the homologous series to which these compounds belong. (1)



A



B

c. The structures of two compounds with the formula C_8H_{18} are shown below.

(i) Compound A has a higher boiling point than Compound B. Explain why. (2)

(ii) Draw the structure of two other compounds with the same formula, C_8H_{18} . (2)

(iii) What name is given to compounds with the same molecular formula, but with different structures? (1)

d. Compound A, C_8H_{18} , can be cracked to produce pentane and propene.

Copy and complete the symbol equation which represents this reaction.



e. Propene can be polymerised.

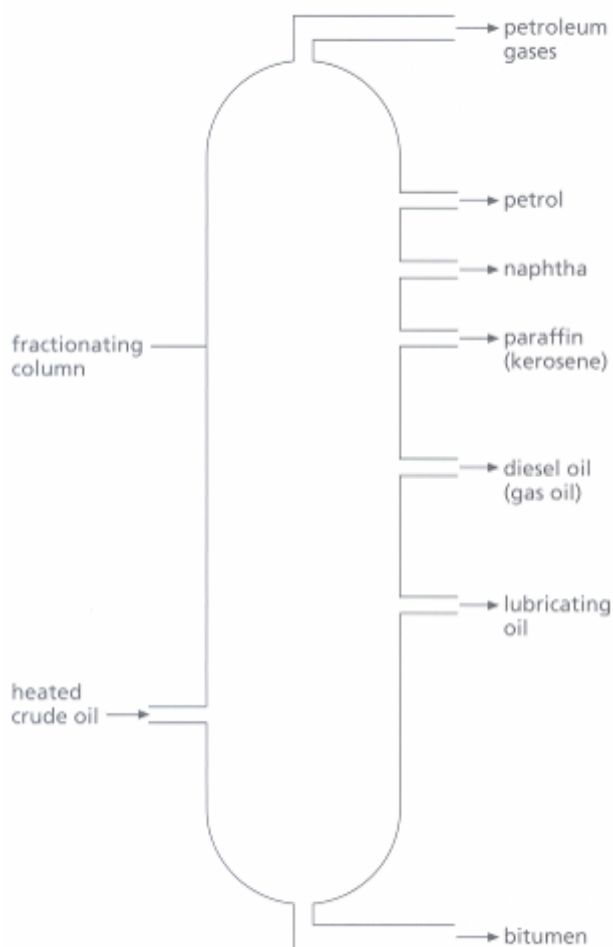
(i) Name the polymer formed. (1)

(ii) Explain the meaning of the term polymerisation. (2)

(AQA, GCSE, Paper 2372, June 2000)

65a. Crude oil (petroleum) is a mixture of compounds called hydrocarbons. Crude oil is heated and then gradually cooled as it passes up through a fractionating column.

The diagram below shows the levels at which some fractions condense.



- (i) Give the names of the two elements found in hydrocarbons. (1)
- (ii) Give the name of the process which is used to separate crude oil into fractions. (1)
- (iii) State the physical property of the hydrocarbons on which the method of separation depends. (1)
- (iv) The petrol fraction is used to supply fuel for motor cars. Name one other fraction used as a fuel. (1)

(v) Give one reason why British oil refineries are usually situated near the coast. (1)

b. Hydrocarbons are used as fuels in everyday life.

(i) Name the two products formed during the complete combustion of a hydrocarbon fuel. (2)

(ii) Explain the danger of the incomplete combustion of hydrocarbon fuels (2)

(WJEC, GCSE, 0125/2, June 1999)

66. Three fuels are:

- petrol
- kerosene
- diesel

a. These fuels are all obtained from the same raw material.

(i) Name this raw material. (1)

(ii) Name the process used to separate these fuels from the raw material. (2)

(iii) Which two of these fuels are used most often in car engines? (1)

b. Each of these fuels contains a mixture of hydrocarbons.

The table shows the formula and boiling point of one hydrocarbon present in each of the fuels.

Fuel	Formula of one hydrocarbon present in the fuel	Boiling point of hydrocarbon/°C
Petrol	C_8H_{18}	126
Kerosene	$C_{11}H_{24}$	196
Diesel	$C_{17}H_{36}$	303

Use information from the table to answer these questions.

(i) Name the two elements present in these hydrocarbons. (2)

(ii) Give the formula of the hydrocarbon with the lowest boiling point. (1)

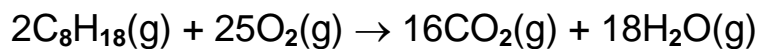
(iii) Give the formula of the hydrocarbon with the smallest molecules. (1)

(iv) Copy and complete the sentence using a word or phrase from the box.

increases decreases stays the same
--

As the size of the hydrocarbon molecule increases, the boiling point _____.
(1)

c. When the hydrocarbon C₈H₁₈ burns, this reaction takes place.



(i) Name the element which reacts with the hydrocarbon. (1)

(ii) What is meant by H₂O(g)? (2)

(iii) During this reaction heat is released. What word describes a reaction which gives out heat? (1)

(Edexcel, Paper 2F/1 F, June 2000)

67. Natural gas and crude oil are important resources.

- a. Describe how these resources were formed in the geological past. (2)
- b. Once formed, crude oil becomes trapped in rock such as sandstone. Briefly explain why crude oil becomes trapped in sandstone.

Use a labelled diagram in your answer, if you wish to do so. (3)

(WJEC, GCSE, June 2000)

68. The table gives the names and formulae of four alkanes in crude oil.

Name	Formula
Methane	CH ₄
Hexane	C ₆ H ₁₄
Decane	C ₁₀ H ₂₂
Hexadecane	C ₁₆ H ₃₄

a. Copy and complete the formula of the alkane containing 8 carbon atoms.

C H (1)

b. Cracking of hexane can produce two hydrocarbons each containing two carbon atoms. One compound has a molecular formula C₂H₆ and the other C₂H₄.

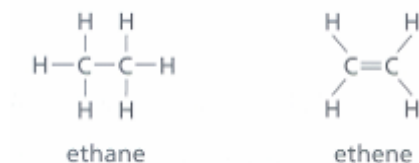
(i) Write a balanced equation for this cracking reaction.

C₆H₁₄ → _____ + _____ (2)

(ii) Suggest two conditions used for this cracking reaction. (2)

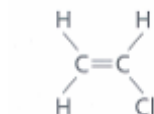
(iii) Explain why the cracking of long chain alkanes from crude oil is important commercially. (3)

(iv) The graphical (displayed) formulae of the two hydrocarbons are



How can the two compounds be distinguished by a simple chemical test? (3)

c. Chloroethene is produced from a hydrocarbon. The formula for chloroethene is



Draw a graphical (displayed) formula for poly(chloroethene). (2)

d. This list includes some of the products formed when methane burns.

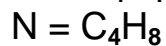
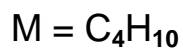
- carbon
- carbon dioxide
- carbon monoxide
- hydrogen
- water

(i) Write down the names of the two products formed by the complete combustion of methane. (2)

(ii) Some water heaters use methane as a fuel. These water heaters need to be checked and serviced regularly. Some people die from breathing the fumes from heaters which have not been serviced. Explain how these fumes are produced and why they are dangerous. (3)

(OCR, GCSE, Paper 2, June 1999)

69. The molecular formulae of two hydrocarbons M and N are given.

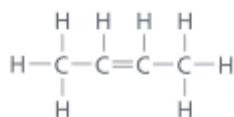


a. M reacts with chlorine to form C_4H_9Cl .

(i) Write a balanced chemical equation for the reaction of chlorine with M. (2)

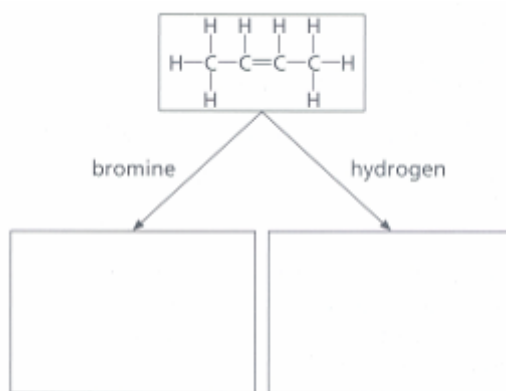
(ii) Name this type of reaction. (1)

b. A displayed structural formula for N is:



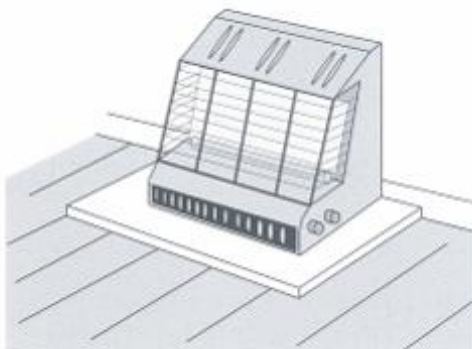
Draw a displayed structural formula of a compound which is an isomer of N. (1)

c. Complete the boxes to show the displayed structural formula for each of the products formed.



(SEG, GCSE, Paper 5, Summer 2000)

70. The gas used as a fuel for heating in most homes is methane, CH_4 .

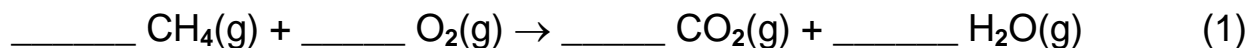


a. It is very important to have a good air supply when methane burns. Explain why. (2)

b. The word equation when methane burns in a good air supply is:

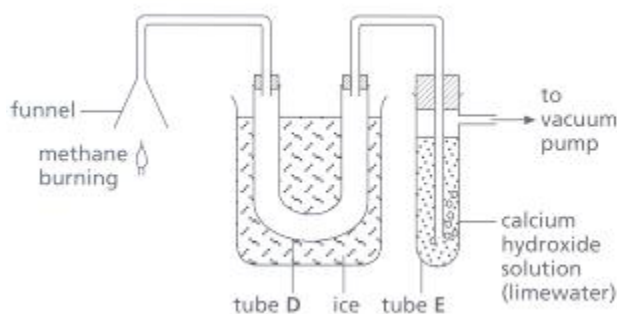


(i) Copy and balance the chemical equation for this reaction.



(ii) Why is this reaction called an exothermic reaction? (1)

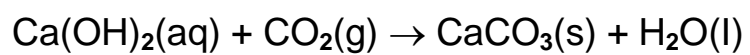
c. The experiment shown was used to test the gases formed when methane burns in a good air supply.



(i) Explain why the water formed collects in tube D. (2)

(ii) Give a chemical test for water. (2)

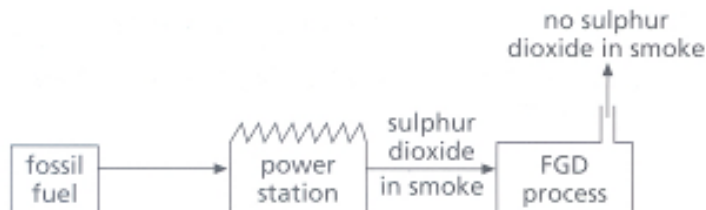
(iii) The reaction that happens in tube E is:



Describe and explain the change you would see in tube E. (2)

(SEG, GCSE, Paper 6/4, June 1999)

71. Some power stations use fossil fuels which are burned and form the pollutant gas, sulphur dioxide. This sulphur dioxide can be removed by a process called Flue Gas Desulphurisation (FGD process).



a. Name a fossil fuel. (1)

b. Why is it important to prevent sulphur dioxide going into the air? Explain your answer. (2)

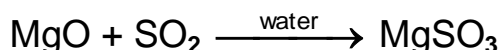
c. Limestone can be used in the FGD process. Limestone reacts with the sulphur dioxide to form calcium sulphite.

(i) What is the chemical name for limestone? (1)

(ii) Calculate the relative formula mass of calcium sulphite, CaSO_3 .

(Relative atomic masses: O 16; S 32; Ca 40.) (2)

d. A solution of magnesium oxide in water can also be used to remove the sulphur dioxide. The reaction is:



Magnesium sulphite, MgSO_3 , can be changed into magnesium oxide and sulphur dioxide.



(i) Give a pH value for a solution of magnesium oxide in water. (1)

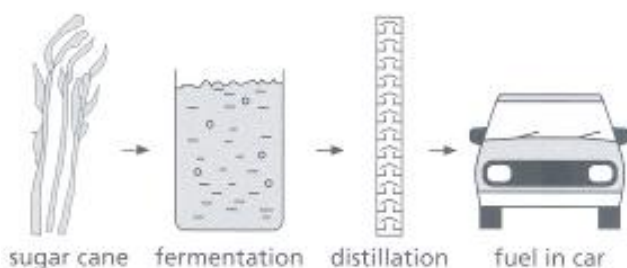
(ii) Suggest why sulphur dioxide reacts with magnesium oxide. (2)

(iii) Suggest how magnesium sulphite can be changed into magnesium oxide and sulphur dioxide. (1)

(iv) Give two uses of sulphur dioxide. (2)

(SEG, GCSE, Paper 5, Summer 2000)

72. Cars in Brazil use ethanol as a fuel instead of petrol (octane). The ethanol is produced by the fermentation of sugar solution from sugar cane.



a. What must be added to sugar solution to make it ferment? (1)

b. What is the most suitable temperature for a fermentation?

0°C 10°C 30°C 70°C 100°C (1)

c.(i) What compounds are formed by the complete combustion of ethanol? (2)

(ii) Why are these compounds not harmful to the environment? (1)

d. Suggest why pollution from cars is less when using ethanol instead of petrol. (1)

e. Give one reason why ethanol is not used as a fuel for cars in Britain. (1)

f. Some information about octane and ethanol is shown.

Property	Octane	Ethanol
Melting point/°C	-57	-113
Boiling point/°C	125	78.5
Density/g/cm ³	0.70	0.79
Heat produced/ kJ/mol	5512	1367

Explain a similarity between octane and ethanol that allows ethanol to be used as a fuel in cars. (2)

(SEG, GCSE, Paper 5, Summer 2000)

73. The table gives the energy required to break some bonds. The number of bonds broken is the same in each case.

Bond	Energy required (kJ)
C—H	435
Cl—Cl	243
H—Cl	432
C—Cl	346

The energy required to break a bond is the same as the energy given out when the bond forms.

In the presence of sunlight, methane will react with chlorine as in the equation.



Calculate the energy transfer in this reaction. You must show your working.
(3)

(OCR, GCSE, Paper 2, June 1999)

74a. The equation shows how hydrazine reacts with oxygen.



Use the bond energy values given in the table to calculate the overall energy change for this

reaction. (3)

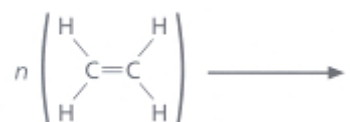
Bond	Bond energy/kJ per mole of bonds
N–N	158
N–H	389
O=O	497
N≡N	945
O–H	464

b. Suggest a reason by hydrazine has been used as a rocket fuel. (1)

(AQA, GCSE, Paper 2372, June 2000)

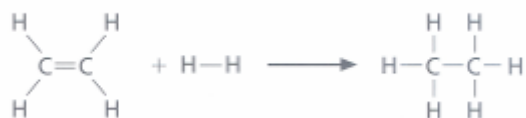
75a. Ethene can undergo polymerisation to form poly(ethene), commonly called polythene.

(i) Copy and complete and balance the equation below to show the polymerisation of ethene. (2)



(ii) Give the name for this type of polymerisation. (1)

b. When ethene reacts with hydrogen, ethane is formed.



The relative amounts of energy needed to break the bonds in the above reaction are shown in the table.

Bond	Amount of energy needed to break the bond/kJ
C=C	612
H-H	436
C-H	413
C-C	347

NOTE: The amount of energy needed to make a bond is equal and opposite to that needed to break the bond.

(i) Using the bond energy values in the table calculate the relative energy

- I. needed to break all the bonds in the reactants, (2)
- II. evolved when the bonds in the product are formed. (2)

(ii) Using your answers to parts I and II explain why the relative overall energy change is exothermic. (1)

(WJEC, GCSE, 0125/2, June 1999)

76a. Ethene is a more useful compound than ethane. One use of ethene is to make the polymer polythene. Write an equation to show how ethene is converted into polythene. (2)

b. Another important polymer is PVC. Give two uses of this polymer and state one property of PVC which makes it suitable for this use. (4)

c. Ethene may also be converted into ethanol by direct combination with water using a catalyst. Write a balanced, symbol equation for this reaction. (2)

(CCEA, GCSE, Paper 2, June 2000)

77a. (i) Polyvinyl chloride (PVC) is a very important and useful plastic. By using an equation show how vinyl chloride molecules link together to form part of a PVC molecule. (3)

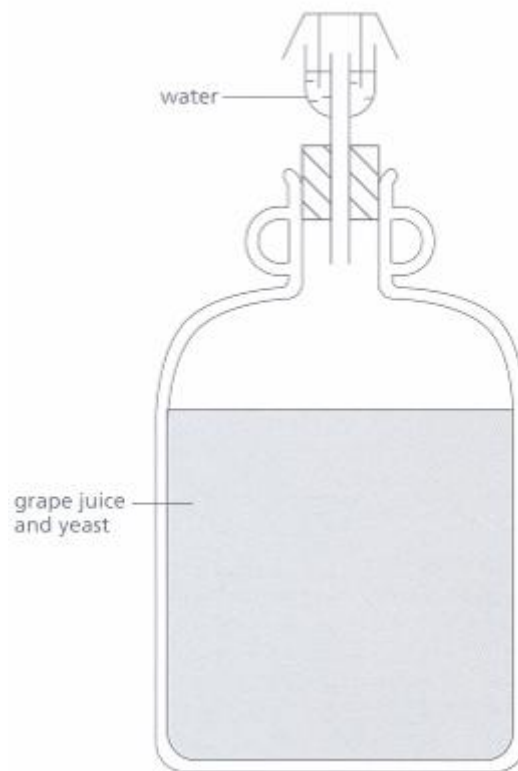
(ii) Give two uses of polyvinyl chloride and state the property of polyvinyl chloride which makes it suitable for the use given. (4)

b. It has been proposed to construct a factory for the production of plastics on a derelict site close to Belfast.

Give one advantage and one disadvantage of siting the factory in this area. (2)

(CCEA, GCSE, Paper 1, June 1999)

78. Home-made wine can be made by putting yeast into grape juice. Here is a diagram of the apparatus which can be used.



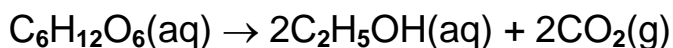
a.(i) Write down the name of this process. (1)

(ii) Write down the name of the gas produced in this process. (1)

b. Explain the job of the yeast in this process. (2)

(OCR, GCSE, Paper 4, June 2000)

79. Glucose can be fermented with yeast to produce ethanol and carbon dioxide. The equation which represents this reaction is shown below.



a.(i) Yeast is needed for the fermentation. Why is yeast not written in the equation? (1)

(ii) Suggest why temperatures above 45°C are not used for fermentation.(1)

b. Use the equation above to help you with the following calculations.

0.10 mole of glucose was completely fermented.

Calculate:

(i) the number of moles of ethanol produced. (1)

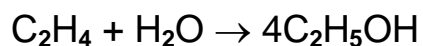
(ii) the mass in grams of ethanol produced.

(Relative atomic masses: H = 1, C = 12, O = 16.) (2)

(iii) the volume, at room temperature and pressure, of carbon dioxide gas produced.

(1 mole of any gas occupies 24 litres at room temperature and pressure.) (1)

c. Most of the pure ethanol made in the United Kingdom is made from ethene. Ethene is reacted with steam in the presence of a catalyst. The equation which represents the reaction is:



Explain why this process is preferred to fermentation by the chemical industry. Your answer should include:

- information about the raw materials
- the type of process

- the rate of reaction
- the quality of the product. (4)

d. Ethanol can be converted to ethanoic acid, CH_3COOH .

(i) What type of reaction takes place when ethanol is converted to ethanoic acid? (1)

(ii) Ethanol and ethanoic acid can react in the presence of an acid catalyst to produce ethyl ethanoate. What type of substance is ethyl ethanoate? (1)

e. Ethanol and ethanoic acid are both colourless liquids at room temperature.

Describe what you would see if sodium carbonate solution was added to each liquid in separate test-tubes. (2)

(AQA, GCSE, Paper 2372, June 2000)

80. Ethanol can be made from sugar solution by the process of fermentation. Fermentation is the method used to make alcoholic drinks.

a. State why distillation can be used to separate the ethanol from the fermented mixture. (1)

b.(i) Give one health problem associated with alcoholic abuse. (2)

(ii) Give one social problem associated with alcoholic abuse. (2)

c. Ethanol in wine is easily changed to ethanoic acid (vinegar).

(i) What causes this change? (1)

(ii) Give the name for the chemical process taking place. (1)

(WJEC, GCSE, June 2000)

81. The flow diagram shows two ways of making ethanol, and some reactions of ethanol.

a. Give the names of

(i) gas A

(ii) process B

(iii) catalyst C

(iv) metal D

(v) type of reaction E

(vi) catalyst F

(6)

b. Fermentation takes place at a temperature of about 35°C.

(i) What happens to this reaction if the temperature is raised to 70°C?

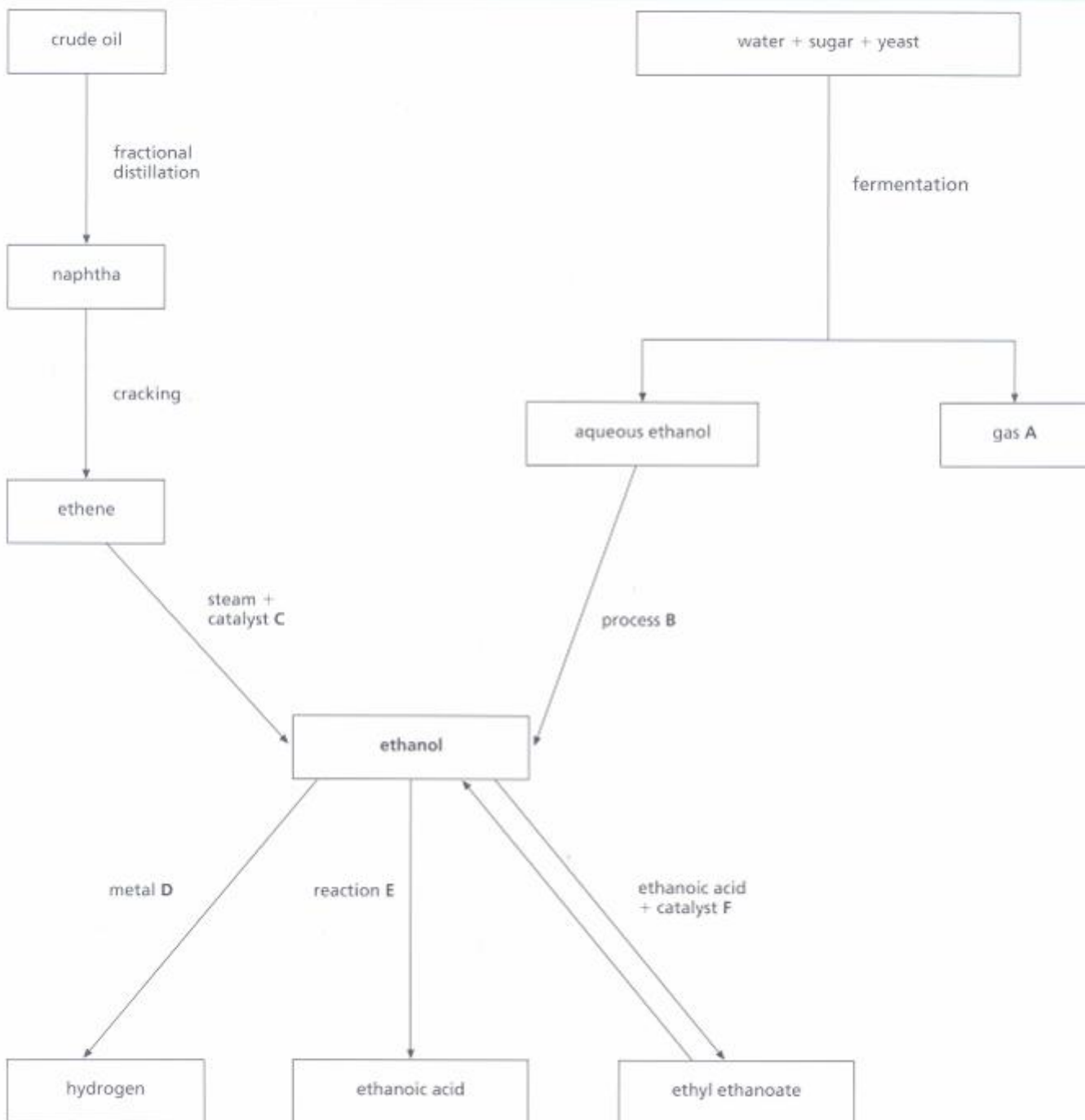
(ii) Give a reason for your answer.

(2)

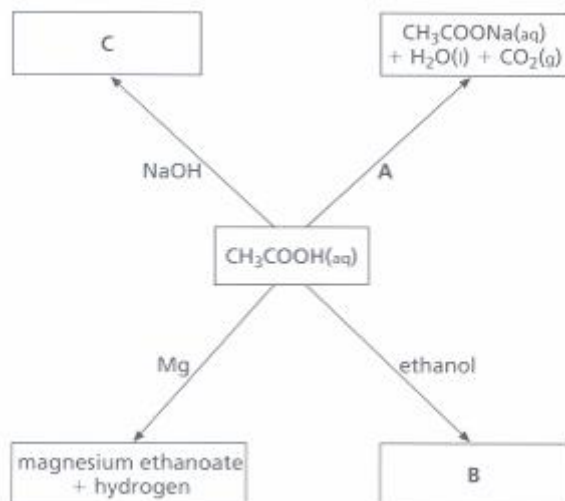
c. Describe the advantages and disadvantages of each of the two processes for making ethanol.

(4)

(AQA, GCSE, Paper 2372, June 1999)



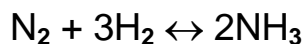
82. Ethanoic acid, CH_3COOH , forms a weak acid when added to water. Some reactions of ethanoic acid are shown.



- Explain what is meant by a weak acid. (2)
- Name the substance A that is added to ethanoic acid. (1)
- Substance B is formed when ethanoic acid reacts with ethanol. What type of substance is B? (1)
- Draw a displayed structural formula for salt C. (1)
- Write a balanced chemical equation for the reaction between magnesium and ethanoic acid. (2)

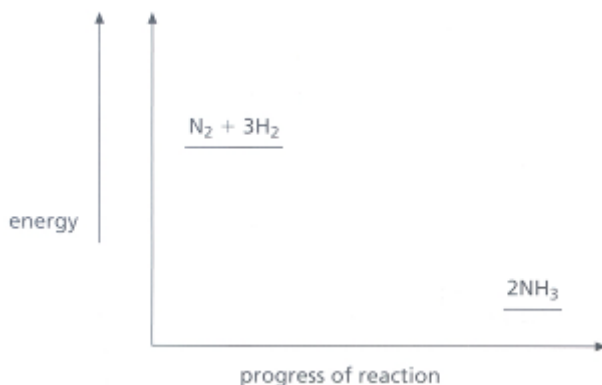
(SEG, GCSE, Paper 5, Summer 2000)

83. This question is about ammonia and fertilisers. Ammonia is made from nitrogen and hydrogen in the Haber process. The equation is



a. Write down the name of the catalyst in this process. (1)

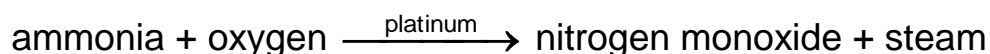
b. The diagram shows the energy change when ammonia is made.



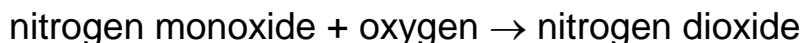
What can you conclude from this energy level diagram? (1)

c. Ammonium nitrate is a fertiliser made from ammonia and nitric acid. Nitric acid is made from ammonia in three stages.

Stage 1



Stage 2



Stage 3



(i) Ammonia is a raw material in this process. What are the other two raw materials? (2)

(ii) In Stage 1, the platinum has to be heated to 900°C to start the reaction. Then the temperature of the catalyst stays at 900°C without the need for further heating. What does this tell you about the first stage? (1)

(OCR, GCSE, Paper 2, June 1999)

84. Read the following poem about the manufacture of ammonia, NH_3 , and answer the questions that follow.

The Haber Process

by Martin Perry

Dry nitrogen and hydrogen gas.
Over a finely divided iron catalyst are passed.
The gases in ratio one to three,
At a pressure of 200 and a temperature of 450 degrees C.

Ammonia gas is produced,
From its choking smell this is deduced.
From the ammonia is made ammonium sulphate,
And also the fertiliser, ammonium nitrate.

(Taken from Chemistry Poems, Education Today, Volume 38 No.2)

a. This word equation represents the reaction between nitrogen and hydrogen.



(i) Write the balanced symbol equation for this reaction. (2)

(ii) The symbol ' \leftrightarrow ' means that the reaction is reversible. Explain what is meant by a reversible reaction. (1)

(iii) The reaction producing ammonia is exothermic. In industry, the conditions used are a pressure of 200 atmospheres and a temperature of 450°C .

Explain fully why both of these conditions are chosen. (5)

b.(i) Calculate the relative formula mass (M_r) of ammonia, NH_3 .

(Relative atomic masses: $\text{H} = 1$, $\text{N} = 14$.)

(ii) Calculate the percentage of nitrogen in ammonia. (3)

c.(i) Ammonium nitrate is a fertiliser. What is a fertiliser? (1)

(ii) Ammonium nitrate is formed when ammonia reacts with nitric acid. Nitric acid is manufactured from ammonia. Describe how nitric acid is made from ammonia.

Your answer should include:

- the types of reaction which occur
- the conditions used
- the energy changes involved. (4)

(AQA, GCSE, Paper 2372, June 2000)

85. Hydrazine, N_2H_4 , is a useful chemical. These are some of its properties:

- colourless liquid
- boiling point, melting point and density are similar to water
- reacts with water to form an alkaline solution
- good at reducing other substances
- produces a lot of energy when reacted with oxygen.

a. Describe a pH test and its results to show that a liquid is hydrazine and not pure water. (2)

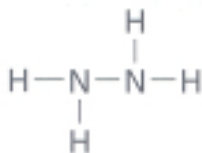
b. When aqueous hydrazine reacts with hydrochloric acid, the salt called hydrazinium chloride is produced.

Copy and complete the name of the salt produced when aqueous hydrazine reacts with nitric acid. (1)

c. Hydrazine is added to the water supplied to industrial boilers. It removes the oxygen dissolved in the water and so helps prevent corrosion of the boiler and pipes.

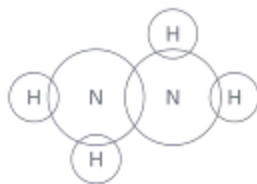
What property of hydrazine given in the list at the start of the question allows it to remove the oxygen from the water? (1)

d. The structural formula of a hydrazine molecule is shown below.



Use a data book to help you to answer this question.

Copy and complete the diagram below to show how the outer energy level (shell) electrons are arranged in a hydrazine molecule. Show the electrons as dots and crosses. (2)



e. Explain why hydrazine has a low boiling point. (2)

(AQA, GCSE, Paper 2372, June 2000)

86a. The Haber process is used to make ammonia, NH_3 . The table shows the percentage yield of ammonia at different temperatures and pressures.

Pressure/ Atmospheres	Percentage (%) yield of ammonia at 350°C	Percentage (%) yield of ammonia at 500°C
50	25	5
100	37	9
200	52	15
300	63	20
400	70	23
500	74	25

(i) Use the data in the table to draw two graphs on a grid. Draw one graph for a temperature of 350°C and the second graph for a temperature of 500°C. Label each graph with its temperature. (4)

(ii) Use your graphs to find the conditions needed to give a yield of 30% ammonia. (1)

(iii) On the grid, sketch the graph you would expect for a temperature of 450°C. (1)

b. This equation represents the reaction in which ammonia is formed.



(i) What does the symbol ' \leftrightarrow ' in this equation tell you about the equation? (1)

(ii) Use your graphs and your knowledge of the Haber process to explain why a temperature of 450°C and a pressure of 200 atmospheres are used in industry. (5)

c. Ammonium nitrate is one type of artificial fertiliser.

(i) Calculate the relative formula mass of ammonium nitrate, NH_4NO_3 .

(Relative atomic masses: H = 1, N = 14, O = 16.) (1)

(ii) Use your answer to part c (i) to help you calculate the percentage by mass of nitrogen present in ammonium nitrate, NH_4NO_3 . (2)

(AQA, GCSE, Paper 2372, June 1999)

87. Ammonia (NH₃) is manufactured from hydrogen and nitrogen in the Haber process.

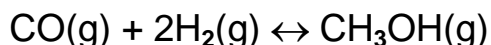
a.(i) Write a balanced equation for the formation of ammonia in the Haber process. (2)

(ii) Draw a dot and cross diagram to show the bonding in a molecule of ammonia. (2)

(iii) Explain, in terms of the bonds broken and formed, why the formation of ammonia from nitrogen and hydrogen is exothermic. (3)

b. The manufacture of methanol from carbon monoxide and hydrogen requires similar conditions to those used in the Haber process.

The equation for the manufacture of methanol is



This reaction is exothermic. The reaction conditions are a pressure of 200 atm and a temperature of 400°C.

(i) State one advantage of using a pressure higher than 200 atm. Explain your answer. (3)

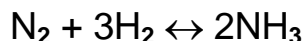
(ii) State one disadvantage of using a pressure higher than 200 atm. (1)

(iii) State one advantage of using a temperature lower than 400°C. Explain your answer. (3)

(iv) State one disadvantage of using a temperature lower than 400°C. Explain your answer. (2)

(Edexcel, GCSE, Paper 3H, June 1999)

88a. Ammonia is manufactured by the Haber process.

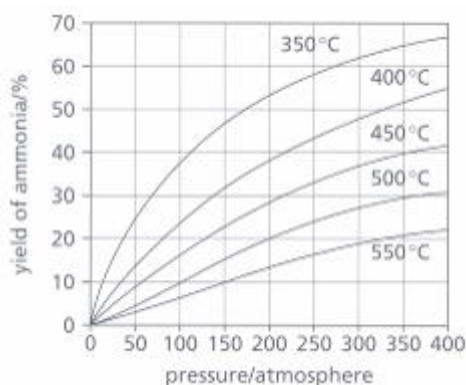


The graph that follows shows the yield of ammonia at different temperature and pressure conditions. Use the graph to answer parts (i) and (ii).

(i) State what happens to the yield of ammonia as the

I. temperature increases (1)

II. pressure increases. (1)



(ii) Find the

I. pressure needed to obtain 40% yield of ammonia at 450°C (1)

II. temperature needed to obtain 20% yield of ammonia at a pressure of 200 atmospheres. (1)

b. State how the rate of ammonia production is increased, apart from changing the temperature and pressure conditions. (1)

c. Ammonia is used to make the nitrogenous fertiliser, ammonium nitrate, NH_4NO_3 . Calculate the relative molecular mass (M_r) of ammonium nitrate. (2)

(Relative atomic masses: $A_r(\text{H}) = 1$; $A_r(\text{N}) = 14$; $A_r(\text{O}) = 16$.)

(WJEC, GCSE, June 2000)

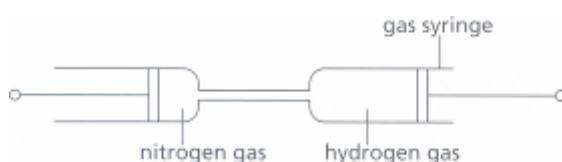
89a. Fertiliser tablets contain compounds of ammonia. Ammonia can be made in the laboratory. Part of the equation for making ammonia is shown below.

This reaction is reversible.

Copy and complete the equation by putting the correct symbol in the box.



b. The diagram below shows the apparatus used to make ammonia.



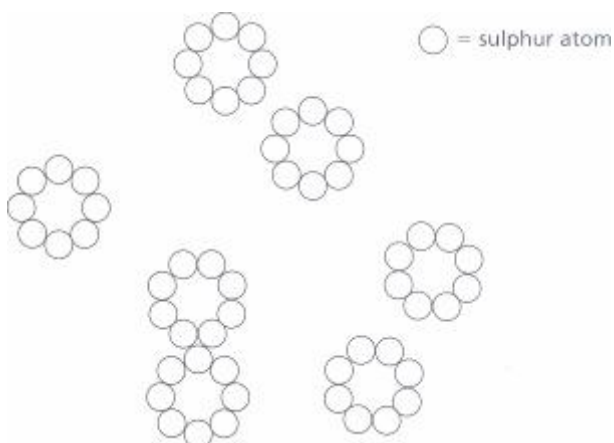
The syringes can be pushed backwards and forwards to mix the gases. The experiment uses a hot iron catalyst. Put a cross on the diagram to show where the catalyst should go. (1)

c. In industry, catalysts are used because they make the process cheaper to run. However, catalysts are very expensive to buy. Explain why it is cost effective to use catalysts in the long term. (2)

d. Three unlabelled test-tubes of gas contain hydrogen, ammonia and nitrogen. You need to identify the three gases. Describe the tests you would do and the results you would expect. (3)

(OCR, GCSE, Paper 2, June 2000)

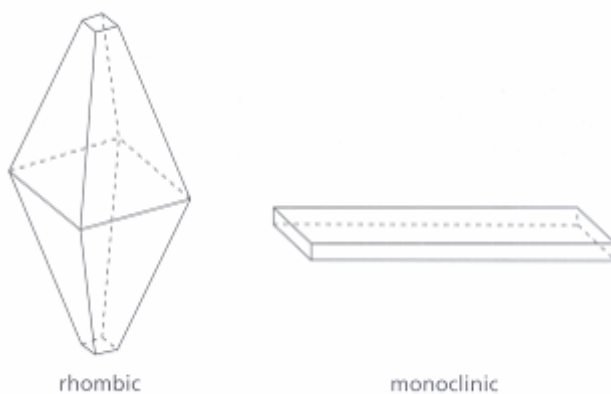
90a. The diagram shows groups of atoms in sulphur.



(i) What is the name given to these groups of atoms? (1)

(ii) Give the correct formula for the structure in part a. (1)

b. Sulphur melts at 119°C . Rhombic and monoclinic sulphur are allotropes which form from molten sulphur.



Some information about the allotropes is in the table.

(i) What is meant by allotropes? (2)

Allotrope	Relative density
Rhombic Stable below 96°C	2.07
Monoclinic Stable above 96°C	1.96

(ii) Suggest why the rhombic allotrope has the higher relative density. (2)

(iii) Explain the changes which happen when molten sulphur is slowly cooled to room temperature. (3)

(SEG, GCSE, Paper 5, Summer 2000)

91a. Sulphur is a yellow, non-metallic element which can exist as allotropes. Define what is meant by the term allotrope and name the allotropes of sulphur.

(i) Definition of allotrope (2)

(ii) The allotropes of sulphur are (3)

b. The most important chemical which can be made from sulphur is sulphuric acid. Describe how sulphur is converted into sulphuric acid stating relevant conditions of temperature, pressure and catalyst as necessary. Write balanced, symbol equations where appropriate. (12)

c. Concentrated sulphuric acid shows reactions which are different from those of dilute sulphuric acid. Describe what you would observe when concentrated sulphuric acid is added to

(i) sugar (3)

(ii) sodium chloride. (2)

(CCEA, GCSE, Paper 2, June 2000)

92a. Sulphuric acid is a very important chemical. Over two million tonnes of the acid are produced in the United Kingdom each year. It has many uses including the production of fertilisers.

(i) Give three other uses of sulphuric acid. (3)

(ii) Describe the various stages in the manufacture of sulphuric acid by the Contact process. Give the names of the raw materials required, the conditions involved and balanced, symbol equations for the reactions. (12)

b. Sulphuric acid is also important in the school laboratory. As a concentrated acid it reacts with copper sulphate crystals and with sodium chloride.

(i) Describe what is observed when concentrated sulphuric acid is added to copper sulphate crystals. (3)

(ii) In the reaction in part b (i), what has the concentrated sulphuric acid acted as? (1)

(iii) Give the balanced, symbol equation for the reaction of concentrated sulphuric acid with sodium chloride. (2)

c. When concentrated sulphuric acid is diluted it acts as a typical acid.

(i) Give the precautions you would take in diluting concentrated sulphuric acid. (3)

(ii) Describe what would be observed when a small amount of copper oxide is added to dilute sulphuric acid and the mixture warmed. (2)

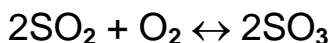
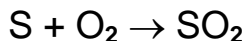
(iii) Give a balanced, symbol equation for the reaction in part c (ii). (2)

(iv) Describe what would be observed when sodium carbonate solution is mixed with dilute sulphuric acid. (2)

(v) Give a balanced, symbol equation for the reaction in part c (iv). (2)

(CCEA, GCSE, Paper 2, June 1998)

93a. Sulphuric acid is produced in the United Kingdom from sulphur. The three main reactions for the production of sulphuric acid are represented by the equations below.



(i) Which reaction uses a catalyst? (1)

(ii) Great care is taken to ensure that gases do not escape from the plant. Explain why. (2)

(iii) Suggest a reason why sulphuric acid plants are often located near a port. (1)

b. Copper sulphate crystals can be used to show that a sample of sulphuric acid is concentrated. Describe what colour change you would see and why the colour changes. (2)

c.(i) A student diluted some concentrated sulphuric acid with water. The student thought the dilute acid was weak. The teacher said that it was still a strong acid.

Why is the acid described as strong? (1)

(ii) The teacher gave the student two solutions. One was a strong acid and the other was a weak acid. The solutions were of the same concentration.

Describe a test the student could do to show which solution was the strong acid and which was the weak acid. Give the results of the test with both solutions. (3)

(AQA, GCSE, Paper 2372, June 1999)

94a. Describe and explain the three main stages in the Contact process for the manufacture of 98% sulphuric acid (concentrated sulphuric acid).

For each stage give the equation for the reaction and details of the reaction conditions.

Stage 1 Production of sulphur dioxide

Stage 2 Conversion of sulphur dioxide to sulphur trioxide

Stage 3 Conversion of sulphur trioxide to 98% sulphuric acid (8)

b. The quantity of sulphuric acid manufactured each year is said to be a good indicator of the success of the industrial economy of the United Kingdom.

Explain, with examples, why the amount of sulphuric acid being manufactured is a good measure of the industrial performance of a nation. (3)

(Edexcel, GCSE, Paper 4H, June 1999)

95. The three main steps in the manufacture of sulphuric acid are:

Step 1 sulphur + oxygen \rightarrow sulphur dioxide

Step 2 sulphur dioxide + oxygen \leftrightarrow sulphur trioxide

Step 3 sulphur trioxide + water \rightarrow sulphuric acid

a. Give the name of the raw material which supplies the oxygen in Steps 1 and 2. (1)

b. What is meant by \leftrightarrow in Step 2? (1)

c. The box below shows conditions used in some industrial processes. Select the conditions used to make sulphur trioxide in Step 2. (3)

Temperature

Pressure

Catalyst

d. The addition of sulphur trioxide to water is too dangerous to carry out in practice. State how sulphur trioxide is converted into sulphuric acid in the industrial process. (2)

atmospheric pressure 200–300 atmospheres pressure 400–500°C room temperature iron vanadium oxide
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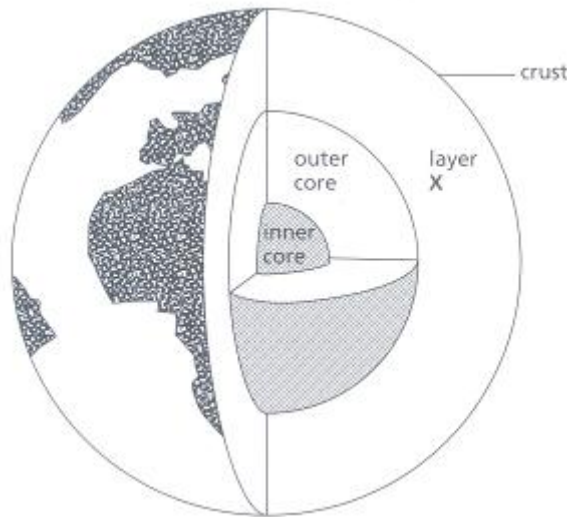
e. State one large scale use of sulphuric acid. (1)

(WJEC, GCSE, 0125/2, June 1999)

96. The diagram represents the layers of the Earth.

a.(i) Give the name of layer X

(1)



(ii) The inner core is smaller and nearer to the centre of the Earth than the outer core. Give one other difference between the inner and outer parts of the core. (1)

b. A student was shown two igneous rocks A and B. Rock A had large crystals. Rock B had small crystals.

(i) Describe how igneous rocks are formed. (2)

(ii) Explain fully why the crystals in Rock A are larger than the crystals in Rock B. (1)

c. Explain why most igneous rocks form near the boundaries of tectonic plates. (2)

(AQA, GCSE, Paper 2372, June 2000)

97. This question is about different types of rocks.

a. The lists show the names of some rocks and descriptions of them.

Link each name to the correct description. Each name must be joined to a different description. One has been done for you.

name of rock	description of rock
basalt	grains arranged in layers of dark and light bands
conglomerate	crystals smaller than 0.5 mm, mainly dark in colour
gneiss	small stones bound together by cementing material
granite	hard, brittle, grey rock that splits into sheets
slate	crystals bigger than 0.5 mm, mainly light in colour

(3)

b. Write down the name of an example of each of the following rock types.

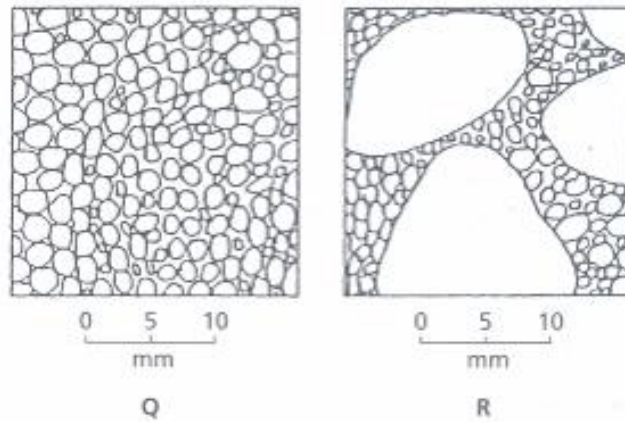
Choose your answers from this list.

basalt conglomerate gneiss granite slate

- | | |
|---------------------------------|-----|
| (i) a sedimentary rock | (1) |
| (ii) a metamorphic rock | (1) |
| (iii) an extrusive igneous rock | (1) |
| (iv) an intrusive igneous rock | (1) |

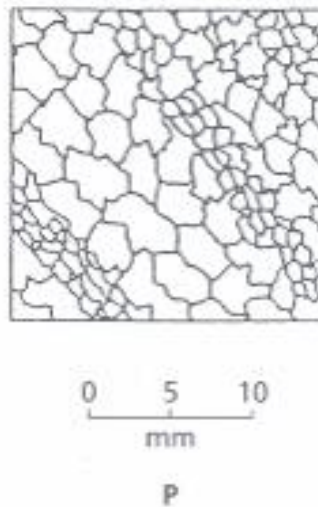
(OCR, GCSE, Paper 2, June 1999)

98a. The diagrams show two rocks, Q and R. These rocks do not fizz with acid.



Use information from a data book to suggest the correct name for Rock Q and Rock R. (2)

b. The diagram below shows a rock P, which was found within a mountain. The rock was formed deep in the Earth's crust.



Is rock P igneous or metamorphic?

Use the diagram to give a reason for your answer. (1)

c. Major features of the Earth's crust include:

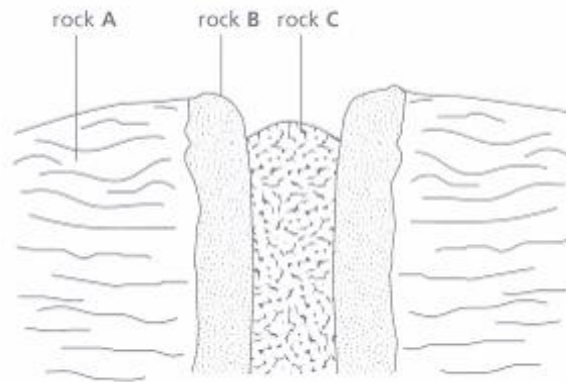
- the present-day continents and oceans
- mountain ranges on land
- deep trenches and volcanic ridges under the oceans.

An early theory suggested these features were the result of the crust shrinking as the Earth cooled down. The modern theory involves the movement of tectonic plates.

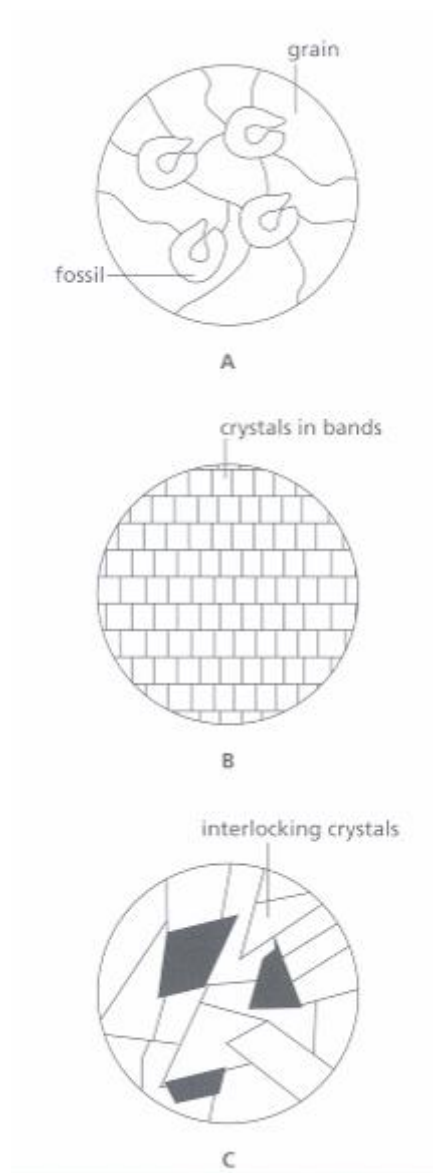
Describe the evidence which led scientists to reject the earlier theory in favour of the modern one. (5)

(AQA, GCSE, Paper 2372, June 1999)

99a. The sketch below was made on a field trip in Wales. A, B and C are three different types of rock.



The diagrams below show what the three rock types look like under a microscope.



(i) Using the words in the box below complete a copy of the table that follows:

granite	igneous	limestone	marble
	metamorphic	sedimentary	

Rock	Type of rock	Name of rock
A		
B		
C		

(ii) Place the rocks, A, B and C in order of their age, with youngest first. (1)

b. Describe how the following rock types are formed.

(i) Sedimentary (2)

(ii) Metamorphic (2)

(WJEC, GCSE, 0125/2, June 1999)

100. The Earth's crust is cracked into a number of large pieces which are moving very slowly.

a. Give the name for these large pieces. (1)

b. State the result of these large pieces slowly moving

(i) apart (1)

(ii) towards each other. (1)

(WJEC, GCSE, 0125/2, June 1999)

101. Two samples of rock from different parts of a volcanic island had the same chemical composition but different crystal sizes.

a. Name this type of rock and describe how it was formed, accounting for the difference between the samples. (4)

b. Analysis of another rock showed that it contained an oxide of tin in which 3.57 g of tin was combined with 0.96g of oxygen.

i) Calculate the empirical formula of the tin oxide present in the rock.

(Relative atomic masses: O = 16, Sn = 119.) (3)

(ii) The melting point of the tin oxide was found to be over 1000°C. Explain why tin oxide has a high melting point and suggest the type of structure it has. (2)

(Edexcel, GCSE, Paper 3H, June 1999)

102. Write a brief account of three of the following. Relevant chemical equations and/or diagrams may be included in your answer where appropriate.

a. Explain how addition polymers can be made from alkenes. Discuss whether the advantages of plastics in everyday life outweigh the disadvantages. (5)

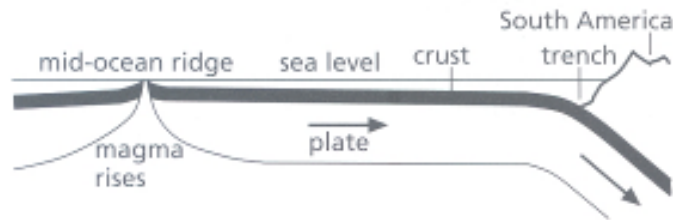
b. Describe and explain the purification of copper. How do the uses of copper in everyday life relate to its properties? (5)

c. Describe how the appearance of rocks is used as evidence to explain their formation and hence to classify rock type. (5)

d. Outline the manufacture of sulphuric acid. (5)

(WJEC, GCSE, June 2000)

103. The diagram below shows one of the plates under the Pacific Ocean. It is always moving, very slowly, towards and under the South American land mass.



a. On a copy of the diagram write:

- (i) S where molten rock is solidifying (1)
- (ii) M where solid rock is melting. (1)

b. Sedimentary rock forms on top of the plate. Describe how sedimentary rock is formed. (3)

(Edexcel, GCSE, Paper 2F/1 F, June 2000)

104. Write a brief account of three of the following. Relevant chemical equations and/or diagrams may be included in your answer where appropriate.

a. Outline the industrial extraction of aluminium. State and explain the major factors that determine the siting of a new aluminium extraction plant. (5)

b. Outline the similarities and differences between alkanes and alkenes. State and explain the importance of alkanes and alkenes in everyday life. (5)

c. Substances can be classified as simple molecular or giant ionic. Give an example for each type of structure and show how the physical properties are related to each structure. (5)

d. State and explain how ethanol can be obtained from sugar. Discuss the dangers of alcohol abuse. (5)

(WJEC, GCSE, 0125/2, June 1999)